

**California Regional Water Quality Control Board
Santa Ana Region**

February 21, 2003

ITEM: 10

SUBJECT: Basin Plan Amendment Workshop: Incorporation of Diazinon and Chlorpyrifos
Total Maximum Daily Load for Upper Newport Bay and San Diego Creek

DISCUSSION

Summary

Upper and Lower Newport Bay and San Diego Creek have been identified as water quality impaired and included on California's 1998 Clean Water Act Section 303d list. Impairment due to aquatic life toxicity has been attributed largely to diazinon and chlorpyrifos (TMDL Report (Appendix A)).

Development of a Total Maximum Daily Load (TMDL) for diazinon and chlorpyrifos in San Diego Creek, and for chlorpyrifos in Upper Newport Bay was initiated in 2001 as part of the TMDLs for toxic pollutants in the Newport Bay Watershed. The United States Environmental Protection Agency (USEPA) worked jointly with Santa Ana Regional Board staff to develop these TMDLs. On June 14, 2002, the USEPA established TMDLs for 14 toxic pollutants, including chlorpyrifos and diazinon. The TMDLs established by USEPA did not include implementation plans.

The purpose of this workshop is to present and receive comments on the proposed amendment to the Water Quality Control Plan [Basin Plan] for the Santa Ana Region to incorporate the diazinon and chlorpyrifos TMDL and an implementation plan. The workshop also serves as a Public Scoping Meeting pursuant to the requirements of the California Environmental Quality Act (CEQA). The purpose of the scoping meeting is to discuss and receive comments on the proper scope and content of the functional equivalent environmental document to be prepared for the proposed amendment pursuant to the RWQCB's certified regulatory program for basin planning under CEQA Guidelines §15251 (g) (at Title 14, Cal Code of Regs. §15251 (g)).

The following discussion summarizes the detailed information concerning the TMDL, including the implementation plan that is provided in the TMDL report. The proposed Basin Plan amendment is shown in Appendix D.

1.0 INTRODUCTION

Newport Bay Watershed

The Newport Bay watershed is located in Orange County, Southern California. The watershed covers an area of 154 square miles (98,500 acres). Cities located partly or fully within the watershed include Orange, Tustin, Santa Ana, Irvine, Lake Forest, Laguna Hills, Costa Mesa, and Newport Beach (Figure 1). The watershed contains large areas of open space, mainly in the foothills and upper areas of the watershed where development has not yet occurred. Newport Bay consists of a highly developed lower

bay south of the Pacific Coast Highway Bridge, and a less developed upper bay that contains a 752-acre ecological reserve. Average rainfall is about 13 inches per year, with 90% of the rainfall occurring between November and April. San Diego Creek is the major drainage channel in the Newport Bay watershed and contributes about 95% of the freshwater flow into Newport Bay.

2.0 IMPAIRMENT ASSESSMENT

Numeric Water Quality Objectives: The Regional Board has not adopted numeric water quality objectives for diazinon and chlorpyrifos. The USEPA has promulgated numeric water quality criteria for California for priority toxic pollutants, but diazinon and chlorpyrifos are not included in this list.

Narrative Water Quality Objectives: The Basin Plan specifies two narrative water quality objectives for toxic substances. These are:

- (1) Toxic substance shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health, and
- (2) The concentration of toxic substances in the water column, sediment or biota shall not adversely affect beneficial uses.

Although diazinon and chlorpyrifos have been detected intermittently in fish and mussel tissue samples from the Newport Bay Watershed, the observed concentrations (with one exception) do not exceed USEPA or OEHHA screening levels. Thus, the first narrative water quality objective (regarding bioaccumulation) is not a concern.

The second narrative objective, however, is not being achieved. San Diego Creek and Upper Newport Bay were listed as impaired due in part, to pesticide-derived toxicity attributable largely to diazinon and chlorpyrifos. Results from 123 toxicity tests have demonstrated the persistent occurrence of aquatic life toxicity in San Diego Creek and Upper Newport Bay.

Antidegradation Policy: As diazinon and chlorpyrifos are man-made chemicals that do not naturally occur in the environment, it can be argued that their presence in surface water constitutes a lowering of the water quality of that surface water. Pursuant to federal and state antidegradation policies, this is permissible only if beneficial uses are protected, and it can be demonstrated that the lowering of water quality is consistent with the maximum benefit to the people of the state of California.

3.0 NUMERIC TARGETS

At present, there are no established numeric water quality objectives for chlorpyrifos and diazinon. The California Dept. of Fish and Game (CDFG) has developed recommended water quality criteria for diazinon and chlorpyrifos derived using USEPA guidelines. These criteria have not been formally adopted, but are the best scientifically derived guidance available. For this TMDL, the selected numeric targets are the recommended acute and chronic criteria derived by the CDFG for chlorpyrifos and diazinon in freshwater and saltwater. Target concentrations are shown in Table 1. These are the same targets identified by the USEPA in the diazinon/chlorpyrifos TMDL promulgated on June 14, 2002.

Table 1. Selected Numeric Targets

Pesticide	Criterion	Concentration (ng/L)	
		Freshwater	Saltwater
Diazinon	Chronic	50	N/a
	Acute	80	N/a
Chlorpyrifos	Chronic	14	9
	Acute	20	20

Calif. Fish & Game (2000). Chronic means 4-consecutive day average

4.0 SOURCE ANALYSIS

Pesticide Usage

Diazinon and chlorpyrifos are among the top pesticides used in Orange County. From 1995 to 1999, diazinon use averaged about 47,000 lbs active ingredient (ai) per year, while chlorpyrifos use averaged about 110,000 lbs ai per year. In 1999, urban uses accounted for over 97% of diazinon use, while agricultural uses (including nurseries) accounted for the remainder. The usage pattern was similar for chlorpyrifos, with over 95% of the use occurring in urban (particularly residential) areas.

USEPA Phaseout of Certain Diazinon and Chlorpyrifos Uses:

In January 2001, USEPA released a revised risk assessment and agreement with registrants to phase out most diazinon uses. Under the agreement, all indoor uses will be terminated, and all outdoor non-agricultural uses will be phased out over the next few years. In addition, on a national basis, about one-third of the agricultural crop uses will be removed. As urban uses account for over 90% of diazinon use in Orange County, it is likely that the EPA agreement will result in cessation of most diazinon use in the Newport Bay watershed.

The USEPA also negotiated a re-registration agreement with registrants for chlorpyrifos in June 2000. The agreement imposes new restrictions on chlorpyrifos use in agriculture, cancels or phases out nearly all indoor and outdoor residential uses, and also cancels non-residential uses where children may be exposed. In Orange County, residential use likely accounts for over 90% of total chlorpyrifos use and thus over 90% of the current chlorpyrifos use in the Newport Bay watershed is likely to be eliminated.

Data Summary

Over 200 water samples have been collected from the Newport Bay watershed during the period 1996-2001. The overall mean diazinon water concentration was 471 ng/L in the watershed drainage channels and 386 ng/L in Upper Newport Bay. Mean values for both baseflow and stormflow samples exceed both the acute and the chronic numeric targets.

Although twice as much chlorpyrifos is used in the watershed as compared to diazinon, the detection frequency for chlorpyrifos was lower than for diazinon. The overall mean chlorpyrifos concentration was 139 ng/L in the watershed drainage channels and 43.4 ng/L in Upper Newport Bay. Mean chlorpyrifos concentrations under both stormflow and baseflow conditions exceed both the acute and the chronic numeric targets (freshwater and saltwater).

Point Sources: There are thirteen individual waste discharge requirement (WDR) or NPDES permit holders in the Upper Newport Bay watershed. In addition, three general NPDES permits and an areawide municipal stormwater permit apply within the San Diego Creek/Newport Bay watershed. The available data do not currently allow separate quantification of pesticide loads from individual permittees.

Groundwater: Groundwater does not appear to be contributing diazinon and chlorpyrifos loads to the drainage system. Diazinon and chlorpyrifos concentrations are lower downstream of areas where groundwater seeps into the drainage channels, indicating that groundwater serves to dilute the concentrations. Diazinon and chlorpyrifos have not been detected in groundwater sampling conducted by the USGS or by the CDPR in the lower Santa Ana River Basin.

Sediment Remobilization: Diazinon has a relatively low potential to adsorb to sediment, while chlorpyrifos is moderately bound to sediment. Based on the physicochemical properties of the pesticides, sediments are not expected to be a continuing long-term source of loads.

Atmospheric Deposition: As chlorpyrifos and diazinon are often detected in rainfall, the significance of atmospheric deposition as a source of diazinon and chlorpyrifos loading will be investigated as part of the TMDL implementation plan. The TMDL report indicates that chlorpyrifos loading could potentially be significant, however this was based on a single rainfall sample collected in the watershed.

Current Loads

The estimated mean annual diazinon load at the SDC-Campus station is about 32 lbs. This amounts to about 0.3% of the estimated 10,800 lbs of diazinon (ai) used within the watershed in 1999. For chlorpyrifos, the total annual mass of chlorpyrifos entering Upper Newport Bay is about 8 pounds. This is about 0.03% of the estimated 24,300 lbs. ai of chlorpyrifos applied in the watershed in 1999.

5.0 TMDL AND ALLOCATIONS

As in the USEPA promulgated TMDL for diazinon and chlorpyrifos, concentration-based allocations are used for this TMDL. The use of a concentration limit rather than a mass load will better ensure prevention of toxic events caused by elevated concentrations of diazinon and chlorpyrifos. An explicit (10%) margin of safety is included, therefore the concentration-based allocations were calculated as 90% of the numeric target level.

Allocations for San Diego Creek

Table 2 presents the concentration-based freshwater allocations for chlorpyrifos and diazinon; these apply to all point sources (wasteload allocations) and to all non-point sources (load allocations). The diazinon allocations apply to freshwater discharges into San Diego Creek Reach 1 and Reach 2. The chlorpyrifos allocations apply to freshwater discharges into San Diego Creek (Reach 1 and Reach 2) and freshwater discharges into Upper Newport Bay.

Table 2. Diazinon and Chlorpyrifos Allocations for San Diego Creek

Category	Diazinon (ng/L)		Chlorpyrifos (ng/L)	
	Acute	Chronic	Acute	Chronic
Wasteload Allocation	72	45	18	12.6
Load allocation	72	45	18	12.6
MOS	8	5	2	1.4
TMDL	80	50	20	14

MOS = Margin of Safety, Chronic means 4-consecutive day average

Allocations for Upper Newport Bay

Table 3 presents the saltwater allocations for chlorpyrifos in Upper Newport Bay. These allocations apply to all point sources (wasteload allocations) and to all non-point sources (load allocations).

Table 3. Chlorpyrifos Allocations for Upper Newport Bay

Category	Acute (ng/L)	Chronic (ng/L)
Wasteload allocation	18	8.1
Load allocation	18	8.1
MOS	2.0	0.9
TMDL	20	9

MOS = Margin of Safety, Chronic means 4-consecutive day average

Needed Reductions: Estimates of the needed concentration reductions required to achieve the TMDL numeric targets in San Diego Creek range from 90% to 97%. Although the estimated reductions are very steep, the USEPA re-registration agreements should result in a sharp decline in observed diazinon and chlorpyrifos concentrations.

Seasonal Variation/Critical Conditions

Pesticide usage exhibits seasonal patterns, with increasing usage in the warmer months due to increased pest activity. However, runoff into the drainage channels is greatest during the wet season, and higher pesticide concentrations are observed during storm events. The chronic criteria used as the basis for the numeric targets are designed to ensure protection of aquatic life during all stages of life, including the most sensitive stages. The concentration-based allocations (Tables 2 and 3) will apply and be protective during all flow conditions and seasons.

6.0 IMPLEMENTATION PLAN

Planned tasks and the schedule for implementation of the TMDL are detailed in the TMDL report (Appendix A). Aside from the USEPA re-registration agreements, these tasks consist of 1) Revision of discharge permits, 2) development of a pesticide runoff management plan, 3) Monitoring, and 4) Special Studies.

1) Permits: The TMDL allocates wasteloads to all dischargers in the watershed. Since the TMDL is concentration-based, the wasteloads are concentration limits. A maximum four-year compliance schedule (beginning in 2003) is proposed. Interim targets for freshwater, based on ½ the LC50 values for *Ceriodaphnia dubia* would apply until June 2005 (220 ng/L for diazinon and 30 ng/L for chlorpyrifos). Compliance schedules would be included in permits only if they are demonstrated to be necessary, and would require compliance as soon as possible, but no later than December 2007.

2) Pesticide Runoff Management Plan: A pesticide runoff management plan (PRMP) will be developed for the watershed as a cooperative project between the Regional Board and stakeholders. The Regional Board will produce an annual report summarizing information from all sources and evaluating the effectiveness of the PRMP. The annual evaluation report will integrate information from the Regional Board's Stormwater, NPDES, and Non-Point Source programs with data from other agencies and from monitoring projects in the watershed.

3) Monitoring: A Regional Monitoring Program (RMP) has been developed for the watershed as part of the nutrient TMDL. The RMP is intended to provide for efficient monitoring of the watershed through a cooperative, comprehensive monitoring program. The OCPFRD is the lead agency for the RMP. All dischargers are allowed to participate in the RMP in lieu of implementing separate, individual monitoring and reporting programs. The RMP currently includes nine stations in the watershed and five stations in Upper Newport Bay. The monitoring plan for this TMDL will utilize the existing RMP and may include additional monitoring from discharge permit holders in the watershed.

4) Special Studies: Two issues were identified during development of the TMDL that require further analysis: 1) The significance of atmospheric deposition to Upper Newport Bay as a separate chlorpyrifos source; and, 2) The adequacy of the freshwater numeric targets for chlorpyrifos in the tributaries to Upper Newport Bay in achieving the lower saltwater numeric target. Regional Board staff will investigate these issues during the implementation period, and the TMDL may be revised if warranted.

ECONOMIC CONSIDERATIONS

The USEPA re-registration agreements for diazinon and chlorpyrifos will result in dramatic reductions in the use of these chemicals, and switches to alternative pesticides. While these new agreements are identified as a key part of this implementation plan, they are not within the Regional Board's jurisdiction and the costs of their implementation cannot be considered TMDL-related costs.

Information concerning the costs of implementation of this TMDL is being solicited during the public participation phase of consideration of this TMDL. Specifically, potentially affected parties are asked to evaluate the TMDL-related costs, as distinct from those associated with implementation of the re-registration agreements. Given that the re-registration agreements will eliminate household uses of these pesticides, the impacts of the TMDL on urban stormwater permittees are expected to be minimal. Expenditures beyond those now necessary to comply with the established areawide urban stormwater permit would likely be focused on increased/enhanced public education efforts to assure proper pesticide use and disposal. Higher costs are likely to be incurred by agricultural operations (nurseries) to assure that Red Imported Fire Ant (RIFA)-related pesticide applications do not result in pesticide runoff.

6.5 PUBLIC PARTICIPATION

Federal regulations at 40 CFR 130.7 require that TMDLs be subject to public review. The Regional Board, in its consideration and adoption of this proposed TMDL, is following the Basin Planning public review process. A working draft of this TMDL is expected to be presented to the Newport Bay Management Committee for review and comments prior to the public workshop scheduled for February 21, 2003. A public hearing is tentatively scheduled for April 4, 2003.

6.6 CONSIDERATION OF ALTERNATIVES

No Project

The "No Project" alternative would be no action by the Regional Board to adopt a TMDL with implementation measures and a monitoring program. This alternative would not meet the purpose of the proposed action, which is to correct ongoing violations of the Basin Plan narrative objective regarding toxic substances and adverse impacts to beneficial uses. This alternative would result in continuing water quality standards violations and threats to public health, and would not comply with the requirements of the Clean Water Act. This alternative would also not be consistent with the USEPA TMDL established in June 2002.

Alternatives based on alternative compliance schedules and/or alternative numeric targets

The Regional Board could consider a TMDL that is based on alternative numeric targets, such as those derived via application of a Probabilistic Ecologic Risk Assessment (PERA). However, the proposed numeric targets are based on the best scientific information now available concerning the toxicity of diazinon and chlorpyrifos and, thus provide the best assurance that the narrative water quality objective for toxic substances will be achieved and that beneficial uses will be protected. The proposed numeric targets are therefore consistent with the purpose of the TMDL. The USEPA has found that the PERA would not assure water quality standards protection as required by the Clean Water Act.

The Board could also consider an alternative TMDL implementation strategy that is based on a different compliance schedule approach. Adoption of a longer schedule would prolong non-attainment of water quality standards. The proposed compliance schedule approach reflects the timing of implementation of the re-registration agreements, which are expected to result in significant reductions in the use of diazinon and chlorpyrifos. The proposed compliance schedule approach is therefore reasonable and attainable.

Proposed Alternative

Staff believes that the recommended TMDL reflects a reasoned and reasonable approach to the reduction of aquatic life toxicity in San Diego Creek and Newport Bay. The proposed implementation schedule also provides a realistic time frame in which to complete the tasks required by the TMDL.

6.7 SCIENTIFIC PEER REVIEW

The TMDL report (Appendix A) has been scientifically peer reviewed. Peer review comments and staff responses are included as Appendix B. The peer review recommended inclusion of additional data on the physiochemical properties and degradation pathways for diazinon and chlorpyrifos. These data have been incorporated into Table 3-1 and Table 4-1 of the TMDL report and additional text describing the hydrolysis pathway for diazinon degradation has been included in Section 4.1.

6.8 ENVIRONMENTAL CHECKLIST

The Basin Planning Process has been certified by the Secretary of Resources as functionally equivalent to the requirement of the California Environmental Quality Act (Public Resources Code Section 21000 *et seq.*) for preparation of an Environmental Impact Report or Negative Declaration.

As previously stated, the February 21, 2003 workshop will serve also as a public scoping meeting to discuss the proper scope and content of the functional equivalent environmental document to be prepared for this proposed amendment.

The Regional Board is required to complete an environmental assessment of any changes it proposes to make to the Basin Plan. The environmental checklist (Appendix E) determines that there are no significant adverse environmental impacts from the proposed Basin Plan Amendment. The amendment package, and supporting documentation are functionally equivalent to an Environmental Impact Report or Negative Declaration.

6.9 PROPOSED BASIN PLAN AMENDMENT

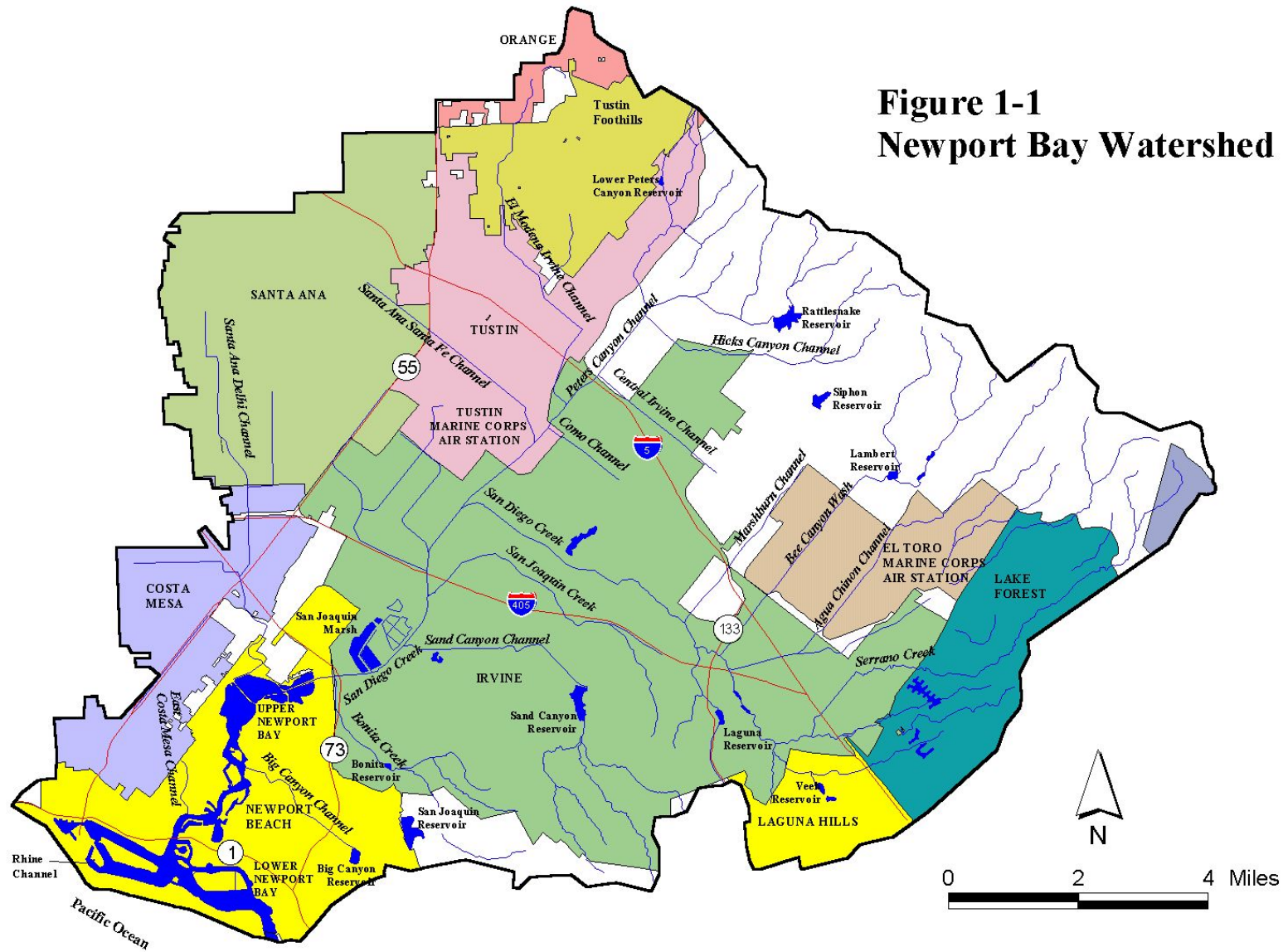
The Basin Plan amendment package includes the following six documents:

1. February 21, 2003 Staff Report
2. TMDL Report
3. Peer Review Comments and Responses
4. Draft Resolution
5. Draft Basin Plan Amendment
6. Environmental Checklist

The TMDL report and peer review documentation are included as Appendices A and B to this staff report. Appendix C contains the draft Resolution No. R8-2003-039, while specific proposed language changes to

the Implementation Plan (Chapter 5) of the Basin Plan are included as an attachment to Resolution No. R8-2003-039 (Appendix D). The environmental checklist is Appendix E.

**Figure 1-1
Newport Bay Watershed**



APPENDIX A

**Diazinon and Chlorpyrifos TMDL
Upper Newport Bay and San Diego Creek**

**California Regional Water Quality Control Board
Santa Ana Region**

February 21, 2003

Diazinon and Chlorpyrifos TMDL: Upper Newport Bay and San Diego Creek

Table Of Contents

Table of Contents	i
List of Tables	ii
List of Figures	iii
1.0 Introduction	1
1.1 Watershed Background	1
2.0 Problem Statement	5
3.0 Numeric Targets	14
4.0 Source Analysis	17
4.1 Physiochemical Properties and Environmental Fate	17
4.2 Pesticide Usage	19
4.3 Data Summary and Analysis	24
4.4 Approach to Calculating Current Loads	34
4.5 Summary and Conclusions	35
5.0 Loading Capacity/Linkage Analysis	38
6.0 TMDL And Allocations	39
7.0 Seasonal Variation/Critical Conditions	41
8.0 Margin Of Safety	42
9.0 Draft Implementation Plan	43
9.1 Introduction	43
9.2 Implementation Tasks	44
9.2.1 USEPA Re-registration Agreements	45
9.2.2 Discharge Permits and Compliance Schedule	45
9.2.3 Pesticide Runoff Management Plan	46
9.2.4 Monitoring	51
9.2.5 Special Studies	51
9.3 Economic Considerations	51
9.4 Potential Funding Sources	53
10.0 References	54

Diazinon and Chlorpyrifos TMDL: Upper Newport Bay and San Diego Creek
List of Tables

<u>Table</u>	<u>Title</u>	<u>Page</u>
Table 1-1	Land Use in the Newport Bay Watershed	1
Table 2-1	Results of <i>Ceriodaphnia</i> Acute Toxicity Tests	12
Table 3-1	Potential Numeric Targets and Reference Values	14
Table 3-2	Selected Numeric Target	16
Table 4-1	Pesticide Properties	17
Table 4-2	Diazinon Formulations Used in Orange County, 1999	18
Table 4-3	Chlorpyrifos Formulations Used in Orange County, 1999	19
Table 4-4	Reported and Estimated Diazinon Use, Orange County: 1995-1999 (lbs ai)	21
Table 4-5	Reported and Estimated Diazinon Use, Orange County: 1995-1999 (%)	21
Table 4-6	Reported and Estimated Chlorpyrifos Use, Orange County: 1995-1999 (lbs ai)	22
Table 4-7	Reported and Estimated Chlorpyrifos Use, Orange County: 1995-1999 (%)	23
Table 4-8	Summary of Diazinon Sampling Results	24
Table 4-9	Diazinon Results by Waterbody Group	25
Table 4-10a	Land Use and Diazinon Stormflow Concentrations: 1996-2000	26
Table 4-10b	Land Use and Diazinon Baseflow Concentrations: 1996-2000	27
Table 4-11	Summary of Chlorpyrifos Sampling Results	28
Table 4-12	Chlorpyrifos Results by Waterbody Group	28
Table 4-13a	Land Use and Chlorpyrifos Stormflow Concentrations: 1996-2000	30
Table 4-13b	Land Use and Chlorpyrifos Baseflow Concentrations: 1996-2000	31
Table 4-14	Estimated Mean Annual Diazinon Load: San Diego Creek, Campus Station	35
Table 4-15	Estimated Mean Annual Chlorpyrifos Load: San Diego Creek, Campus Station	35
Table 6-1	Diazinon and Chlorpyrifos Allocations for San Diego Creek	39
Table 6-2	Chlorpyrifos Allocations for Upper Newport Bay	40
Table 6-3	Needed Load (concentration-based) Reductions for San Diego Creek	40
Table 9-1	TMDL Task Schedule	44
Table 9-2	Numeric Target Compliance Schedule	46
Table 9-3	Selected CDPR-Reported Pesticides Used in Orange County, 1999	47

Diazinon and Chlorpyrifos TMDL: Upper Newport Bay and San Diego Creek
List of Figures

<u>Figure</u>	<u>Title</u>	<u>Page</u>
Figure 1-1	Newport Bay Watershed: Cities	3
Figure 1-2	Newport Bay Watershed: Topography	4
Figure 2-1	TSMP Fish Tissue Data: Peters Canyon Channel	9
Figure 2-2	TSMP Fish Tissue Data: San Diego Creek at Michelson Dr.	9
Figure 2-3	<i>Ceriodaphnia</i> Toxicity Tests in the Newport Bay Watershed, Baseflow: 1996-2001	10
Figure 2-4	<i>Ceriodaphnia</i> Toxicity Tests in the Newport Bay Watershed, Stormflow: 1996-2001	10
Figure 4-1	Reported Diazinon Use, Orange County: 1995-1999	20
Figure 4-2	Reported Chlorpyrifos Use, Orange County: 1995-1999	22
Figure 4-3	Newport Bay Watershed: Sampling Stations S1-S12	37

1.0 INTRODUCTION

On June 14, 2002, the United States Environmental Protection Agency (USEPA) established Total Maximum Daily Loads (TMDLs) for 14 toxic pollutants, including chlorpyrifos and diazinon in San Diego Creek and Upper Newport Bay (USEPA 2002). The USEPA TMDL for chlorpyrifos and diazinon was based on a draft TMDL prepared by staff of the Santa Ana Regional Water Quality Control Board (SARWQCB). To address impairment specified in the 1998 Section 303(d) list, the TMDL addressed diazinon and chlorpyrifos in both reaches of San Diego Creek and chlorpyrifos in Upper Newport Bay. TMDLs are required despite recent re-registration agreements to phase out certain uses of these two organophosphate pesticides by 2006 (USEPA 2001, 2000a).

This document summarizes the information presented in the USEPA TMDL document (USEPA 2002) and presents additional information related to the problem statement (Section 2) and development of the numeric targets (Section 3). The source analysis is discussed in Section 4. Loading capacity, allocations, seasonal variation, and the margin of safety are discussed in Sections 5,6,7, and 8, respectively. Finally, Section 9 of this document presents the implementation plan for the TMDL. The remainder of this introduction provides background information on the Newport Bay Watershed.

1.1 Watershed Background

The Newport Bay watershed is located in Orange County, Southern California. The watershed covers an area of 154 square miles (98,500 acres). Cities located partly or fully within the watershed include Orange, Tustin, Santa Ana, Irvine, Lake Forest, Laguna Hills, Costa Mesa, and Newport Beach (Figure 1-1). The watershed consists largely of the Tustin Plain, bounded to the east by the Santiago hills and by the San Joaquin hills to the west (Figure 1-2).

Land Use

Table 1-1 provides the latest available land use data for the San Diego Creek drainage and the Newport Bay watershed as a whole.

Table 1-1. Land Use in the Newport Bay Watershed

Land Use	San Diego Creek		Newport Bay Watershed	
	Acres	Percent	Acres	Percent
Vacant	21,910	28.5 %	23,462	23.9 %
Residential	11,668	15.2 %	19,420	19.7 %
Education/Religion/Recreation	15,811	20.6 %	17,393	17.7 %
Roads	10,295	13.4 %	15,774	16.0 %
Commercial	6,381	8.3 %	9,641	9.8 %
Industrial	3,965	5.2 %	5,263	5.4 %
Agriculture	5,092	6.6 %	5,147	5.2 %
Transportation	1,177	1.5 %	1,326	1.3 %
No code	440	0.6 %	936	0.9 %
Total	76,739	100%	98,362	99.9 %

Source: Orange County Public Facilities and Resources Department, provided March 2002

The watershed contains large areas of open space, mainly in the foothills and upper areas of the watershed where development has not yet occurred. Agriculture, while once more widespread, is now largely confined to areas north of Interstate 5 (Figure 1-1), and accounts for slightly more than five percent of the watershed area. The middle and lower portions of the watershed are more urbanized.

Newport Bay consists of a highly developed lower bay south of the Pacific Coast Highway Bridge (Highway 1), and a less developed upper bay that contains a 752-acre ecological reserve. The ecological reserve provides important coastal wetland habitat for six endangered bird species and two endangered plant species.

Climate

The climate of the watershed is characterized by short, mild winters, and dry summers. Average rainfall is about 13 inches per year, with 90 percent of the rainfall occurring between November and April.

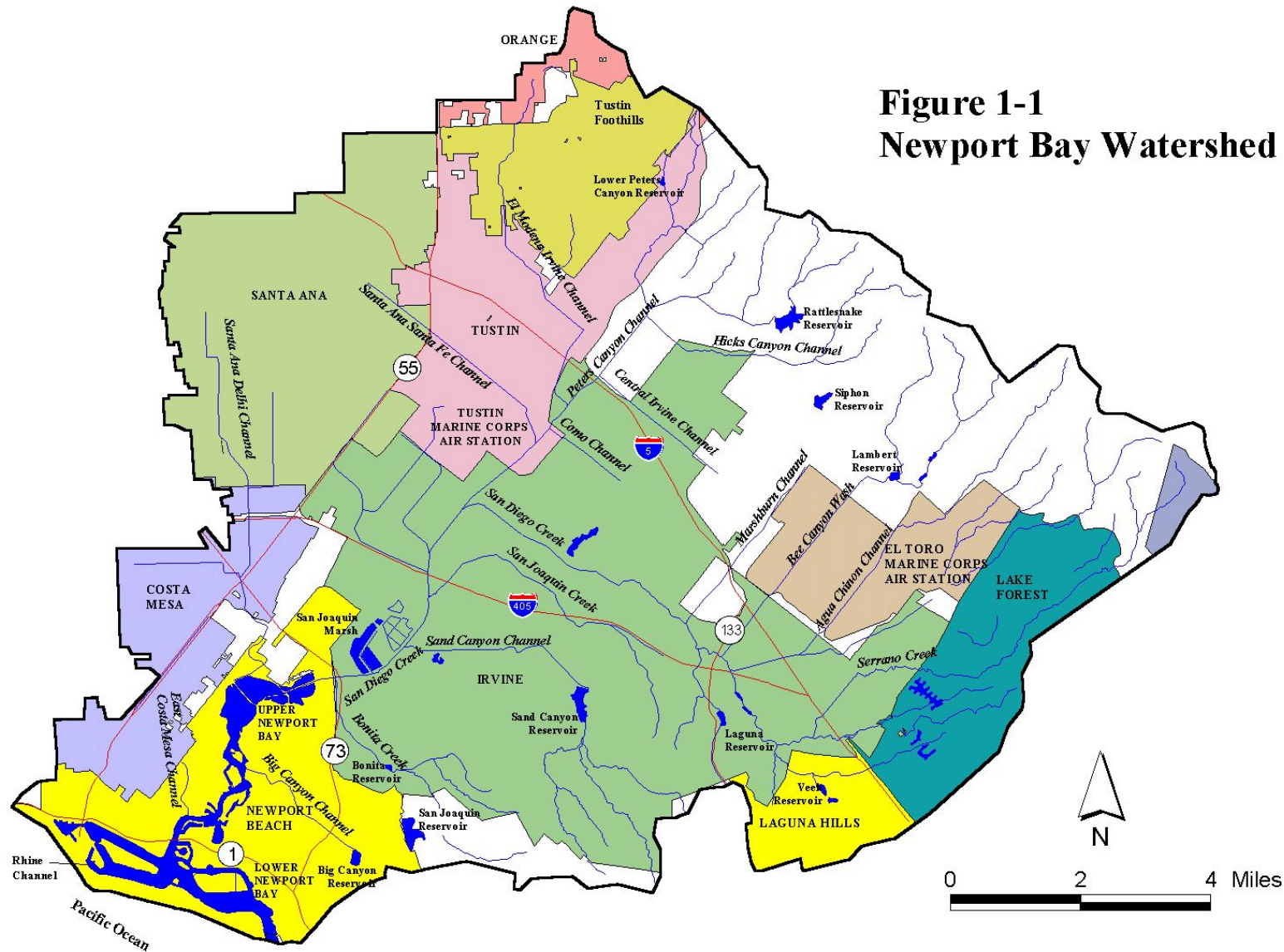
Hydrology

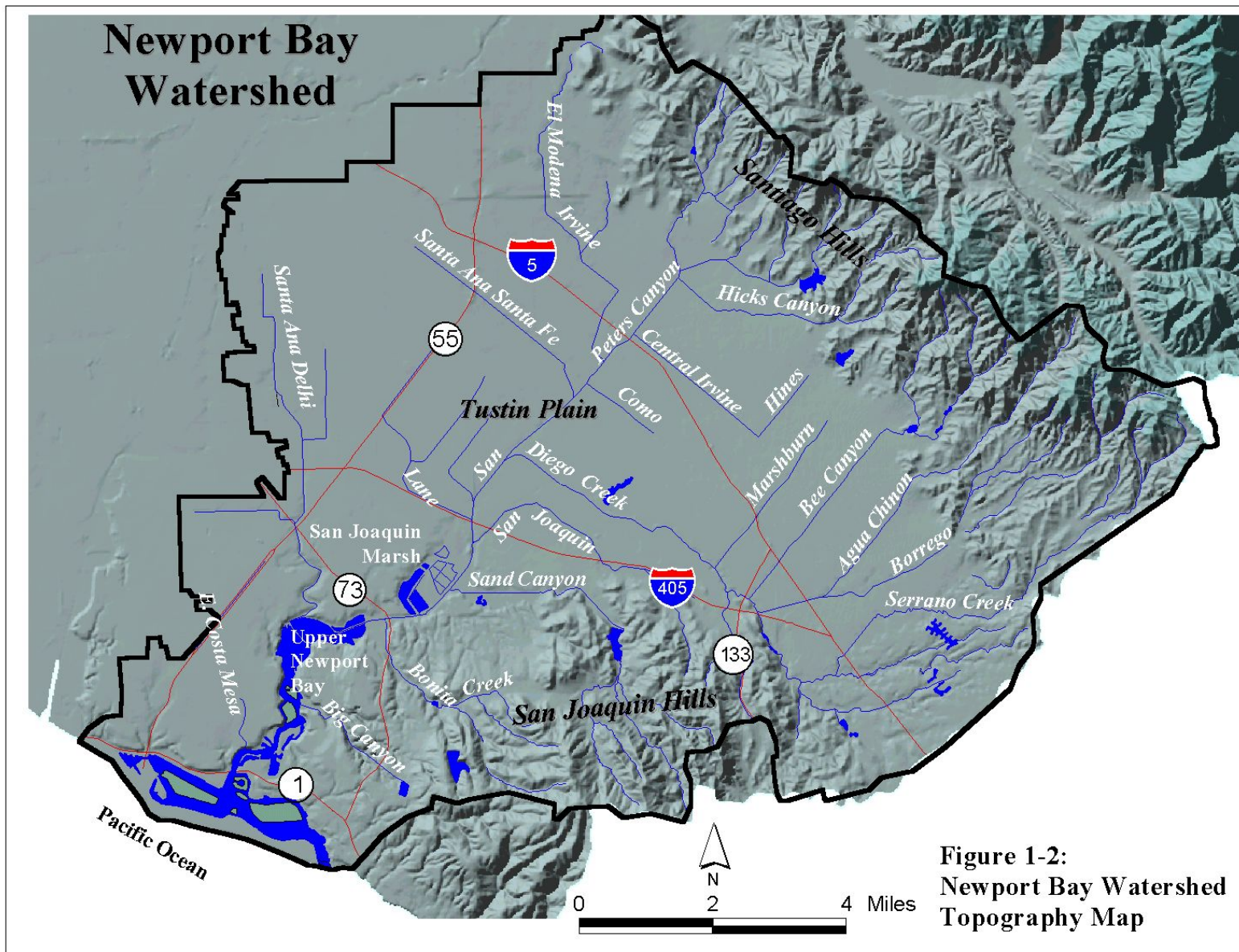
San Diego Creek is the major drainage channel in the Newport Bay watershed and contributes about 95% of the freshwater flow volume into Upper Newport Bay. San Diego Creek is divided into two reaches. Reach 1 is designated as the length from Upper Newport Bay to Jeffrey road (a point approximately two miles downstream of Marshburn channel), while Reach 2 is the remaining section to the headwaters of the creek. The drainage area of San Diego Creek (including its largest tributary, Peters Canyon Channel) accounts for about 77% of the watershed.

Daily flow records for San Diego Creek at the Campus Drive monitoring station reveal a wide range of flow rates. In dry weather, baseflow typically ranges from 8 to 15 cubic feet per second (cfs). During wet weather, daily storm flows in San Diego Creek can range up to about 9,200 cfs, although most storm flows fluctuate between 20 and 815 cfs (Orange County Public Facilities and Resources Department [OCPFRD] data).

The second largest drainage in the watershed is that of the Santa Ana Delhi channel, which accounts for 11% of the watershed area, and provides about 5% of the freshwater flow to Upper Newport Bay. Average dry weather flows in the Santa Ana Delhi channel are typically between 1 and 2 cfs, with storm flows ranging up to 1,370 cfs.

**Figure 1-1
Newport Bay Watershed**





**Figure 1-2:
Newport Bay Watershed
Topography Map**

2.0 PROBLEM STATEMENT

An investigation of stormwater runoff in tributaries to Newport Bay in 1992 and 1993 demonstrated the existence of aquatic life toxicity (Bailey et al 1993). A toxicity identification evaluation (TIE) performed on several of the samples collected during the study, indicated that one or more pesticides were responsible for the observed toxicity, and that diazinon was likely one of these pesticides.

Separate sampling programs, the Toxic Substances Monitoring Program (TSMP), and the State Mussel Watch (SMW), demonstrated that chlorpyrifos and diazinon were present in fish and mussel tissue. The TSMP and SMW were conducted in upper and lower Newport Bay as well as in the drainage channels in the Newport Bay watershed, with diazinon and chlorpyrifos data available from 1983 onwards.

As a result of these investigations, upper and lower Newport Bay and Reach 1 of San Diego Creek were included on California's 1998 Clean Water Act Section 303d list for pesticides. Reach 2 of San Diego Creek was listed for unknown toxicity.

Supplemental studies to determine the sources of the toxicity observed during the 1992-93 investigation were carried out from 1996 to 2000 (Lee and Taylor 1999, 2001). These studies further documented the occurrence of aquatic life toxicity in the Newport Bay watershed, and concluded that diazinon and chlorpyrifos were causing a large portion of the observed toxicity in San Diego Creek. An investigation of Upper Newport Bay indicated the presence of toxicity attributable to chlorpyrifos in stormwater runoff entering the upper bay from San Diego Creek (Lee and Taylor 1999, 2001). No samples were collected from lower Newport Bay.

Based on these findings, TMDL development for diazinon and chlorpyrifos in San Diego Creek, and chlorpyrifos in upper Newport Bay was initiated (Santa Ana Regional Water Quality Control Board [SARWQCB] 2001). Diazinon and chlorpyrifos are widely used organophosphate pesticides, and are among the pesticides detected most frequently in urban waterways. Further details on diazinon and chlorpyrifos usage in the Newport Bay watershed can be found in Section 4.

The remainder of this problem statement summarizes previous investigations in the Newport Bay watershed and describes the impairment of water quality standards caused by pesticide-derived aquatic life toxicity.

Previous Investigations/Available Data

This TMDL is based primarily on analysis of data collected in the Newport Bay watershed during the period 1996-2000. The available data were generated by state and local agencies as part of various investigative or monitoring programs. These programs are briefly described below.

1. Toxic Substances Monitoring Program (TSMP) and State Mussel Watch (SMW): The TSMP and SMW are statewide screening programs designed to identify areas where toxic substances

are bioaccumulating in fish and mussel tissue. The TSMP includes four locations in the Newport Bay watershed, one location in Upper Newport Bay, and one location in Lower Newport Bay. Sample analysis for diazinon and chlorpyrifos began in 1983, and has continued at irregular intervals through 2000 (State Water Resources Control Board [SWRCB] 2001, TSMP Database 1983-2000). The SMW program includes sample collection for diazinon and chlorpyrifos analysis from 19 locations, mostly within Upper and Lower Newport Bay. Although some of the locations were sampled only once or twice since 1982, annual samples have been collected at several locations for over ten years (SWRCB 2000, SMW Database, 1980-1996).

2. Aquatic Life Toxicity Investigations; 319(h) and 205(j) studies: These studies were funded under the USEPA Clean Water Act Section 205(j) and 319(h) grant programs. The first study (under the 205(j) program) was carried out from 1996-1999. Eighty-five samples were collected from seven stormwater runoff events and four dry-weather sampling events. The second study (under the 319(h) program) was carried out during 1999 and 2000. Three stormwater runoff events and two dry weather events were monitored, and a total of 31 samples were analyzed for diazinon and chlorpyrifos. Acute toxicity tests were performed on 63 of the samples collected under the 205(j) and 319(h) studies. Further details on these studies can be found in the respective reports (Lee and Taylor 1999, 2001).

3. Orange County Public Facilities and Resources Department (OCPFRD): Orange County has been implementing a water quality monitoring program since 1991 as part of the areawide municipal stormwater permit issued to Orange County and its co-permittees. Although no diazinon and chlorpyrifos analyses are currently required under this permit, the OCPFRD has collected semi-annual sediment data for diazinon analysis.

3. California Department of Pesticide Regulation (CDPR) Pesticide Use Reports: Beginning in January 1990, California required growers to report all pesticides used on all crops. All pesticides applied on golf courses, parks, cemeteries, rangeland, pasture, and along roadside and railroad rights-of-way were also subject to the expanded reporting requirements. Pesticide dealers also faced expanded reporting and record keeping requirements. Structural fumigators, professional gardeners and other nonagricultural Pest Control Operators continued to report all pesticide use. Home-use pesticides are exempt from the regulations.

4. CDPR Red Imported Fire Ant (RIFA) Monitoring: The RIFA is an aggressive, exotic insect that was first discovered in Southern California in October 1998. In response, the California Department of Food and Agriculture (CDFA) designed a RIFA eradication/control plan to deal with the infestations (CDFA 1999). Part of the plan required treatment of targeted areas with a suite of pesticides that included diazinon and chlorpyrifos.

To monitor the environmental impact of the RIFA plan, a surface water sampling program was initiated in Orange County, conducted by the CDPR. Over 100 samples were collected and analyzed for pesticides during the period March 1999 to January 2001. These included 22 rounds of monthly sampling and one rainfall runoff sampling event. Acute toxicity tests were performed on 60 samples. Data from the sampling events are summarized in monthly monitoring memos (CDPR 1999-2000).

5. CDPR Sales and Use Survey: The CDPR and the University of California conducted a residential pesticide survey to better document the residential use occurring in the Newport Bay watershed. A project report was published in 2001 (Wilén 2001).

Water Quality Standards

Water quality standards include beneficial uses, water quality objectives (numeric and narrative) and an antidegradation policy.

Beneficial Uses: Beneficial Uses for San Diego Creek are designated in the Basin Plan (SARWQCB, 1995). San Diego Creek Reach 1 has the following designated beneficial uses:

- Water contact recreation (REC1)
- Non-contact water recreation (REC2)
- Wildlife habitat (WILD)
- Warm freshwater habitat (WARM)

The Basin Plan identifies the same uses for Reach 2, but, in this case, the uses are designated as intermittent. In addition, Reach 2 has the intermittent groundwater recharge (GWR) beneficial use designation (SARWQCB, 1995).

Designated beneficial uses for Upper Newport Bay include REC1, REC2, and WILD, as well as the following:

- Preservation of Biological Habitats of Special Significance (BIOL)
- Commercial and Sport Fishing (COMM)
- Estuarine Habitat (EST)
- Marine Habitat (MAR)
- Rare, Threatened, or Endangered Species (RARE)
- Spawning, Reproduction, and Development (SPWN)
- Shellfish Harvesting (SHEL)

Numeric Water Quality Objectives: The Regional Board has not adopted numeric water quality objectives for diazinon and chlorpyrifos. The USEPA has promulgated numeric water quality criteria for California for priority toxic pollutants, but diazinon and chlorpyrifos are not included in this list.

Narrative Water Quality Objectives: The Basin Plan specifies two narrative water quality objectives for toxic substances. These are:

- (1) Toxic substance shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health, and
- (2) The concentration of toxic substances in the water column, sediment or biota shall not adversely affect beneficial uses.

Antidegradation Policy: As diazinon and chlorpyrifos are man-made chemicals that do not naturally occur in the environment, it can be argued that their presence in surface water constitutes a lowering of the water quality of that surface water. Pursuant to federal and state antidegradation policies, this is permissible only if beneficial uses are protected, and it can be demonstrated that the lowering of water quality is consistent with the maximum benefit to the people of the state of California.

IMPAIRMENT ASSESSMENT

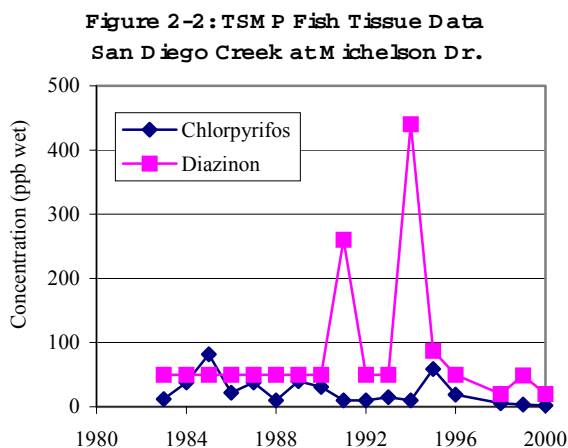
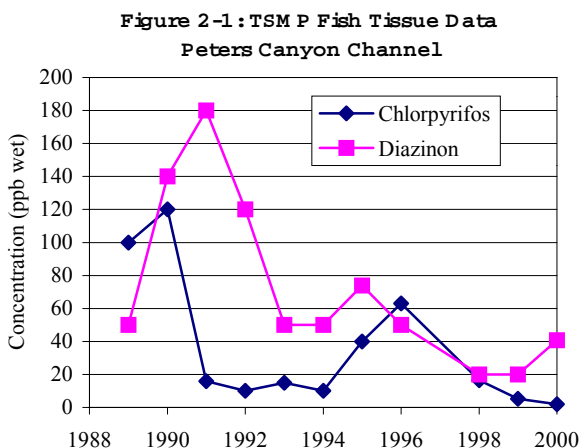
Bioaccumulation/Food Consumption Guidelines

The USEPA has established recommended screening values for diazinon and chlorpyrifos in fish tissue. The screening values are intended to identify chemical concentrations that may be of human health concern for frequent consumers of sport fish. The USEPA tissue screening values are 900 ppb and 30,000 ppb for diazinon and chlorpyrifos respectively (wet weight). The California Office of Environmental Health Hazard Assessment (OEHHA) published a study (the California Lakes Study) in 1999 that calculated screening values for diazinon and chlorpyrifos (OEHHA 1999). These screening values were calculated using EPA guidance, with the only difference being a fish consumption rate three times higher than used by USEPA. As a result, the OEHHA screening values were 300 ppb and 10,000 ppb (one-third the USEPA values).

The TSMP and SMW programs have collected fish and mussel tissue samples from the Newport Bay watershed. Samples have been collected from both Upper and Lower Newport Bay, and from San Diego Creek and its tributaries.

TSMP data: Chlorpyrifos tissue concentrations have consistently remained orders-of-magnitude below the OEHHA screening value (10,000 ppb) for fish consumption. Diazinon concentrations have exceeded the OEHHA screening value of 300 ppb only once (440 µg/kg) during the program's history. Figures 2-1 and 2-2 show the TSMP results for the two stations where the longest record of data is available (Peters Canyon Channel and San Diego Creek at Michelson), and where the highest diazinon concentration was observed.

SMW data: Diazinon and chlorpyrifos concentrations in mussel tissue have never exceeded the OEHHA guidelines. The observed concentrations were only detected intermittently and there is no trend apparent in the data. Detection frequencies were 40% and less than 10% for chlorpyrifos and diazinon, respectively.



(OEHHA Screening Values: Diazinon = 300 ppb; Chlorpyrifos = 10,000 ppb)

Although diazinon and chlorpyrifos are detected intermittently in the TSMP and SMW programs, the concentrations observed in the Newport Bay watershed do not provide evidence of bioaccumulation to levels of concern.

Aquatic Life Toxicity

San Diego Creek and Upper Newport Bay were listed as impaired due in part to pesticide-derived toxicity. Although a mixture of pesticides was associated with the toxicity, the primary sources of toxicity were identified as diazinon and chlorpyrifos. The impairment was documented through acute toxicity tests conducted on 123 water samples from 1996 to 2001. The toxicity tests were performed as part of the 205(j) and 319(h) programs, and as part of the DPR-RIFA water quality investigation. In addition, nurseries in the Newport Bay watershed that have waste discharge permits began conducting bimonthly chronic toxicity tests in 2000.

Figures 2-3 and 2-4 summarize all the toxicity test results using *Ceriodaphnia dubia*, (the most sensitive of the test species). Eighty-one toxicity tests were conducted on baseflow samples collected in the Newport Bay watershed. Toxicity to *Ceriodaphnia* was not present in 20% of these tests, while 80% of the tests resulted in at least partial (<100%) mortality to *Ceriodaphnia* (Figure 2-3).

**Figure 2-3: Ceriodaphnia Toxicity Tests in the Newport Bay Watershed
Baseflow; 1996-2001**

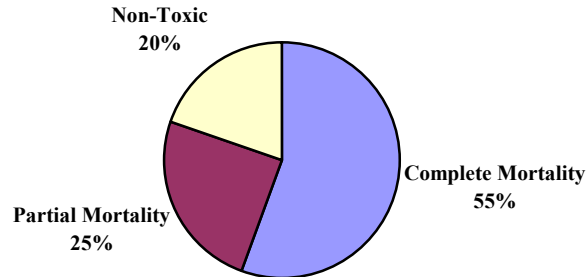
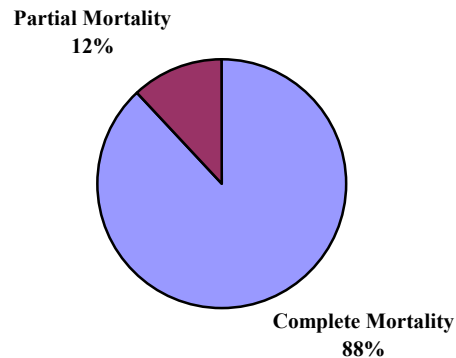


Figure 2-4 summarizes the stormwater toxicity data. Forty-two toxicity tests using *Ceriodaphnia* were conducted on stormwater samples collected from various locations in the Newport Bay watershed. All samples were toxic to *Ceriodaphnia*, with 88% of the samples causing complete (100%) mortality within a few days.

**Figure 2-4: Ceriodaphnia Toxicity Tests in the Newport Bay Watershed
Stormflow; 1996-2001**



Aquatic Life Toxicity Investigations (319(h) and 205(j) Programs)

A total of 63 undiluted samples were collected for acute toxicity testing during the 205(j) and 319(h) investigations. Several additional samples required dilution prior to testing due to salinity levels that were high enough to cause mortality to one of the test organisms (*Ceriodaphnia dubia*). With serial dilutions and TIE procedures, over 300 toxicity tests were conducted on the water samples.

Acute toxicity attributable to diazinon and chlorpyrifos occurred in San Diego Creek during virtually all monitored storm events. Dry weather toxicity was generally confined to the upper reaches of the watershed and diluted or otherwise ameliorated upstream of monitoring locations in San Diego Creek. (Lee and Taylor, 1999, 2001) In the 319(h) study, 100% *Ceriodaphnia* mortality was observed in virtually all storm samples, usually within 2 days. Stormwater runoff samples, with the salinity adjusted to that of seawater, were also acutely toxic to the saltwater test species *Mysidopsis bahia*. The toxicity to *Mysidopsis* is attributable to the chlorpyrifos concentration in the samples.

Most of the toxicity tests performed under the 319(h) program were conducted using serial dilutions to measure the acute toxic units present. TIEs were also performed in many cases to identify the specific constituents responsible for the observed toxicity.

Table 2-1 shows toxicity test data on samples collected in the Newport Bay watershed during the 319(h) investigation. The data are sorted by the expected toxicity based on the water column concentrations, and reference LC50s for diazinon and chlorpyrifos. The LC50 is the concentration of a toxic constituent that results in 50% mortality to the test organism. For Table 2-1, the reference LC50s are those published by the CDFG (CDFG 2000a: diazinon = 440 ng/L and chlorpyrifos = 60 ng/L). Measured toxicity that exceeds the expected toxicity suggests the presence of additional compounds at toxic concentrations. Based on TIE work performed on these samples, the additional toxicity is mainly attributable to carbaryl, and potentially to some pyrethroid pesticides. Several samples still had significant toxicity that was due to unknown causes.

Samples with the highest measured toxicity in February 2000, have been linked to an isolated toxic event caused by runoff from agricultural fields that were treated with carbaryl. Carbaryl was applied to deal with an infestation of cutworms in strawberry fields. A pellet-like bait formulation was selected to minimize offsite migration, however, the baits were carried into the drainage channels during the storms in February. (John Kabashima, personal communication 2002).

A report summarizing the TIE work done on the February 21, 2000 sample set is included as Appendix C of the 319h report (Lee and Taylor, 2001).

**Table 2-1: Results of 319(h) *Ceriodaphnia* Acute Toxicity Tests
(sorted by expected diazinon and chlorpyrifos toxicity)**

Station	Date	GC Results (ng/L)		Mortality		Acute Toxicity (TUa)	
		Chlorpyrifos	Diazinon	(%)	(days)	Measured	Expected
San Joaquin Creek – Univ Dr.	12-Feb-00	770	<50	100	1	32	12.8
San Joaquin Creek – Univ Dr.	21-Feb-00	470	<50	100	1	6	7.8
San Diego Creek - Harvard Av.	12-Feb-00	310	280	100	1	8	5.8
Hines Channel - Irvine Blvd.	29-Sep-99	310	220	100	1	16	5.7
San Diego Creek - Campus Dr.	12-Feb-00	260	460	100	1	8	5.4
Central Irvine Channel - Monroe	12-Feb-00	150	810	100	1	8	4.3
Hines Channel - Irvine Blvd.	12-Feb-00	120	760	100	1	8	3.7
Peters Canyon Channel - Walnut	12-Feb-00	150	520	100	1	16	3.7
San Diego Creek - Harvard Av.	21-Feb-00	190	200	100	1	3	3.6
San Diego Creek - Campus Dr.	25-Jan-00	160	320	100	1	8	3.4
San Diego Creek - Campus Dr.	21-Feb-00	170	220	100	1	5	3.3
Hines Channel - Irvine Blvd.	21-Feb-00	50	810	100	1	5	2.7
Peters Canyon - Barranca	12-Feb-00	100	420	100	1	8	2.6
Peters Canyon - Barranca	21-Feb-00	80	330	100	1	3	2.1
Peters Canyon - Barranca	29-Sep-99	<50	820	100	1	2	1.9
Central Irvine Channel - Monroe	21-Feb-00	70	280	100	1	5.5	1.8
East Costa Mesa - Highland Dr.	12-Feb-00	<50	370	100	2	n/a	1.7
East Costa Mesa - Highland Dr.	21-Feb-00	<50	560	100	1	2.5	1.3
El Modena-Irvine upstream of PCC	21-Feb-00	<50	330	100	6	0	0.8
East Costa Mesa - Highland Dr.	31-May-00	<50	210	100	5	1	0.5
Santa Ana Delhi - Mesa Dr.	21-Feb-00	<50	200	100	7	0	0.5
El Modena-Irvine upstream of PCC	31-May-00	<50	180	0	0	0	0.4
Peters Canyon – Barranca	31-May-00	<50	170	0	0	0	0.4
San Diego Creek - Campus Dr.	31-May-00	<50	160	0	0	0	0.4
Santa Ana Delhi - Mesa Dr.	12-Feb-00	<50	120	100	3	1	0.3
Santa Ana Delhi - Mesa Dr.	31-May-00	<50	110	0	0	0	0.3
Sand Canyon Ave - NE corner Irv. Blvd.	12-Feb-00	<50	110	22	7	0	0.3
Central Irvine Channel - Monroe	31-May-00	<50	90	n/a	n/a	n/a	0.2
Sand Canyon Ave - NE corner Irv. Blvd.	21-Feb-00	<50	70	30	7	0	0.2
Hines Channel - Irvine Blvd.	31-May-00	<50	47	44	7	n/a	0.1
San Diego Creek - Harvard Av.	31-May-00	<50	<50	0	0	0	0.0

n/a = not available; TUa = acute toxic units; GC= Gas Chromatography
(Adapted from Lee and Taylor, 2001)

DPR-RIFA: Acute Toxicity Tests

The DPR has completed 22 sampling rounds in the Newport Bay watershed. Sixty acute toxicity tests have been performed using *Ceriodaphnia dubia*. The DPR-RIFA tests were not accompanied by serial dilutions or TIEs, and identification of the toxic constituents was based on expected toxicity derived from reference LC50 data.

The DPR has not completed detailed data analysis for the RIFA monitoring project, however, preliminary analysis indicates that chlorpyrifos and diazinon are responsible for most of the observed toxicity in San Diego Creek. At the nursery discharge monitoring locations, bifenthrin appears to account for a significant portion of the toxicity in addition to diazinon, and chlorpyrifos. However, bifenthrin is relatively immobile compared to diazinon and chlorpyrifos, and has been detected in only one of 22 DPR monthly sampling events downstream in San Diego Creek (CDPR, 1999-2001).

Nurseries: Chronic Toxicity Tests

The nurseries in the Newport Bay watershed began performing chronic toxicity tests on their effluent in 2000. As of January 2001, Hines Nurseries had completed seven chronic toxicity tests, and El Modeno Gardens had completed two chronic toxicity tests. Bordiers Nursery had not yet conducted chronic toxicity tests.

Test results were generally 2 chronic toxic units (TUc) for reproduction and 1-2 TUc for survival. DPR data show that the mix of pesticides causing toxicity in nursery discharge typically includes diazinon, chlorpyrifos, and bifenthrin (CDPR, 1999-2001).

SUMMARY

Toxicity tests have been performed on 123 water samples collected from the Newport Bay watershed. These tests have demonstrated the persistent occurrence of aquatic life toxicity in San Diego Creek and its tributaries, and in Upper Newport Bay, particularly during storm events. Based on water column chemistry data and TIEs, there is conclusive evidence that diazinon and chlorpyrifos are causing acute and chronic toxicity in San Diego Creek and Upper Newport Bay (chlorpyrifos). There is no compelling evidence of bioaccumulation of these substances to levels of concern.

The persistent occurrence of aquatic life toxicity in San Diego Creek and Upper Newport Bay is evidence of impairment, or at least threatened impairment of the established beneficial uses of these waterbodies. Adverse impacts to these beneficial uses are violations of the second narrative objective specified in the Basin Plan (SARWQCB, 1995).

3.0 NUMERIC TARGETS

At present, there are no established numeric water quality objectives for chlorpyrifos and diazinon. Two methods have been proposed for setting numeric targets in the Newport Bay watershed. These are:

- (1) The CDFG (2000a) water quality criteria for diazinon and chlorpyrifos derived using USEPA guidelines (USEPA 1985). Note that these criteria have not been formally adopted, but are the best scientifically derived guidance available.
- (2) A Probabilistic Ecological Risk Assessment (PERA) for diazinon implemented by Novartis (Hall and Anderson 2000). This method could also be applied for chlorpyrifos.

Table 3-1 shows potential diazinon and chlorpyrifos concentration targets, along with several reference concentrations for comparison.

Table 3-1 Potential Numeric Targets and Reference Values

Source	Concentration (ng/L)	
	Freshwater	Saltwater
DIAZINON		
CDFG chronic criterion	50	---
CDFG acute criterion	80	---
Probabilistic Ecological Risk Assessment (PERA) Arthropods 5th percentile	144	---
<i>Ceriodaphnia</i> chronic, acute NOECs	220, 350	---
<i>Ceriodaphnia/Mysidopsis</i> (LC50 or EC50)	440	4,500
Stormwater Mean	445	---
Maximum	960	---
CHLORPYRIFOS		
CDFG chronic criterion	14	9
CDFG acute criterion	20	20
<i>Ceriodaphnia</i> chronic NOEC	29	---
<i>Ceriodaphnia/Mysidopsis</i> (LC50 or EC50)	60	40
Stormwater Mean	87	43.3
Maximum	580	132

CDFG=California Department of Fish and Game. LC50=lethal concentration 50%. EC50=Effects concentration 50%. LC50 and EC50 from CDFG(2000a); NOEC=No Observed Effects Concentration

USEPA Method as Applied by CDFG: The USEPA method provides for development of an acute and a chronic concentration criterion. The acute criterion is referred to as the Criterion Maximum Concentration (CMC), and the chronic criterion is referred to as the Criterion Continuous Concentration. The use of two criteria is intended to be less restrictive than “a one-number criterion would have to be in order to provide the same degree of protection” (USEPA 1985).

The CMC is designed to “estimate the highest one-hour average concentration that should not result in unacceptable effects on aquatic organisms and their uses.” The CCC is designed to “estimate the highest four-day average concentration that should not cause unacceptable toxicity during a long-term exposure” (USEPA, 1985).

The frequency of allowed exceedance for both the CCC and CMC is set as once in three years, an interval deemed sufficient to allow ecosystems to recover from the stress caused by the exceedance. The CCC and CMC are intended to provide protection to 95% of the species in the data set, and are derived by using acceptable toxicity tests from a representative set of species.

In accordance with USEPA (1985) guidance, the CDFG recommended criteria were derived using toxicity data from eight families of aquatic animals. Acute toxicity values (LC50s and EC50s) were assembled from tests that met standard acceptance protocols defined in USEPA guidelines (1985) and ASTM standards. For diazinon, a total of 40 acceptable tests from 15 genera were used, and for chlorpyrifos a total of 33 acceptable tests from 18 genera were used. Genus mean acute values (GMAVs) were calculated using the geometric means of the reported acute values (LC50s or EC50s), and the four lowest GMAVs were used to calculate the acute criteria. Chronic criteria were derived using acute-to-chronic ratios.

The USEPA methodology includes provisions to account for bioaccumulation, and for toxicity to plant species, if warranted. As discussed previously, bioaccumulation is not a concern for diazinon and chlorpyrifos. Toxicity to aquatic plants is also not a significant concern, based on toxicity test results in the Newport Bay watershed using the algae *Selenastrum capricornatum* (no toxicity present in any of the tests).

PERA Method: The PERA is a risk assessment, and is more comprehensive in scope than the USEPA method. The PERA approach characterizes risk to aquatic species by comparing distributions of environmental exposure data with distributions of species response data (toxicity data) from laboratory studies. The overlap of these distributions is a measure of potential risk to aquatic life.

The numeric target for the PERA is derived by pooling available toxicity tests to form a cumulative frequency distribution. The desired level of protection is then selected by choosing appropriate percentiles from the distribution (usually the 5th or 10th percentiles). In the Newport Bay watershed PERA, performed by Novartis (Hall and Anderson 2000), the 5th and 10th percentiles were determined separately for the entire toxicity data set (all species) and for arthropods (the most sensitive phylum to diazinon). The 5th percentile for arthropods corresponds to protection of 95% of arthropod species, and is similar to the USEPA acute criterion, which is designed to be protective of 95% of the species included in the representative data set.

Differences between the USEPA method and the PERA as implemented by Novartis include differing statistical methods for grouping and averaging the data, and the additional requirement in the USEPA method for selection of a representative set of taxa.

However, the major difference between the USEPA method and the PERA is the inclusion of a safety margin in the USEPA method. Although both methodologies are based on statistically determining the 5th percentile of the toxicity test data, the USEPA method includes a final step to divide the 5th percentile value by a factor of two. The rationale for this safety margin is that the toxicity test data are based on LC50s. Using the LC50 without the safety margin implies a numeric target that allows 50% mortality (or greater) at the selected level of protection (5th percentile). But as stated by USEPA, “a concentration that would severely harm 50% of the 5th percentile cannot be considered to be protective of that percentile or that species” (USEPA, 1985). Noting this point, USEPA Region IX has stated that the PERA method as implemented by Novartis, is not considered protective under the Clean Water Act (USEPA 2000b).

For this TMDL, the selected numeric targets are the recommended acute and chronic criteria derived by the California Dept. of Fish and Game for chlorpyrifos and diazinon in freshwater and saltwater (CDFG 2000a). These numeric targets serve as the quantitative interpretation of the second narrative water-column quality objective as specified in the Basin Plan (1995). These numeric targets will be protective of aquatic life in San Diego Creek and Upper Newport Bay and sufficient to remove impairment caused by diazinon/chlorpyrifos toxicity. Target concentrations are shown in Table 3-2; saltwater chronic and acute targets for diazinon are not applicable since TMDLs are not required for this pollutant in any of the saltwater bodies covered by these TMDLs.

Table 3-2 Selected Numeric Targets

Pesticide	Criterion	Concentration (ng/L)	
		Freshwater	Saltwater
Diazinon	Chronic	50	N/a
	Acute	80	N/a
Chlorpyrifos	Chronic	14	9
	Acute	20	20

Calif. Fish & Game (2000a). Chronic means 4-consecutive day average

The CDFG applied the USEPA methodology by assembling a database of available toxicity tests and evaluating each test for inclusion in the set of tests used for calculating the acute and chronic recommended criteria. The numeric targets selected for this TMDL are the recommended acute and chronic criteria derived by the CDFG (CDFG 2000a). These concentrations are shown in Table 3-2. Setting numeric targets at the CDFG-derived criteria will ensure that aquatic organisms and their uses should not be affected unacceptably if the four-day average concentrations do not exceed the chronic numeric targets (Table 3-2), more than once every three years on the average, and if the one-hour average concentrations do not exceed the acute numeric targets (Table 3-2) more than once every three years on the average.

4.0 SOURCE ANALYSIS

This section of the TMDL presents a synopsis of the major sources of diazinon and chlorpyrifos to San Diego Creek and chlorpyrifos to Upper Newport Bay. This synopsis focuses on water column concentrations from several studies conducted in the watershed targeting aquatic life toxicity associated with pesticides (Lee and Taylor 1999, 2001; CDPR studies). These studies were not detailed enough to identify discrete sources, but it is generally recognized that these pesticides occur in non-point source runoff from both agriculture and urban use.

The analysis in this section is intended to evaluate diazinon and chlorpyrifos data collected in the watershed relative to the numeric targets, and provide general estimates of average diazinon and chlorpyrifos loading rates to San Diego Creek and Upper Newport Bay. This information is used primarily to evaluate the relative importance of different categories of sources in the watershed.

4.1 Physicochemical Properties and Environmental Fate

The environmental fate of chlorpyrifos and diazinon can be inferred from their physical properties. Table 4-1 presents properties for diazinon and chlorpyrifos along with several other pesticides that occasionally contribute to the aquatic life toxicity in San Diego Creek. In general, diazinon and chlorpyrifos are a more significant water quality threat because of the combined properties of higher toxicity, mobility, and persistence. Carbaryl, for example, is mobile but less toxic and less persistent than diazinon and chlorpyrifos.

Table 4-1. Pesticide properties

Pesticide	<i>Ceriodaphnia</i> LC50 (ng/L)	Solubility (mg/L)	Adsorption Coefficient (dim'less)	Henry's Law (atm-mol/m ³)	Vapor Pressure (mmHg)	Half-Lives (days)	
						Soil	Water
Bifenthrin	78	0.1	1,000,000	n/a	n/a	7-240	n/a
Carbaryl	3,380	40	300	1.27×10^{-5}	4.1×10^{-5}	7-28	10
Chlorpyrifos	60	2	6070	4.16×10^{-6}	1.87×10^{-5}	60-120	30-75
Diazinon	440	40	1000	1.13×10^{-7}	8.47×10^{-5}	14-28	180
DDT	4,700	<1	100,000	n/a	n/a	2-15 years	20-60
Malathion	1,140	130	2.75	4.89×10^{-9}	1.25×10^{-6}	1-25	< 7

Sources: EXTONET Pesticide Information Profiles; CDFG (2000a); Montgomery (1993)

n/a=not available; dim'less=dimensionless

Relative to most pesticides, diazinon is fairly soluble and mobile in aquatic systems. It is only weakly bound by sediment. In contrast, chlorpyrifos is much less soluble and has a much higher potential to adsorb to soil and sediment.

Diazinon

In general, diazinon is relatively persistent in aquatic environments with a half-life of about six-months under neutral pH conditions. The pH of the channel network in the Newport Bay watershed is generally between 7.5 and 8, a range that would maintain the stability of diazinon. In soil, the diazinon half-life is shorter owing to greater microbial degradation.

For diazinon, major routes for dissipation are hydrolysis, biodegradation, volatilization, and photolysis (USEPA 1999a). Diazinon degrades rapidly by hydrolysis under acidic conditions (half-life of 12 days at pH 5). Hydrolysis is slower under neutral and alkaline conditions (abiotic hydrolysis half-lives of 138 days at pH 7, and 77 days at pH 9). Degradation is fastest from bare soil, followed by vegetation, and aquatic environments. Biodegradation from impervious urban areas (walkways, pavement) would be slowest due to the relative absence of microbes. This indicates that diazinon may accumulate in residential areas until rainfall runoff carries it into the drainage channel network. In a residential runoff survey conducted in the Castro Valley Creek watershed, diazinon was found in all samples as long as seven weeks after application (Scanlin and Feng 1997).

Diazinon dissipation half-lives do not appear to be correlated with formulation type (granular, wettable powder, or emulsifiable concentrate). The reported diazinon formulations in Orange County for 1999 are listed in Table 4-2. The liquid formulations are likely to be the most mobile as they are already in soluble form. The granules would likely remain available until a storm event washed the remaining active ingredient into the storm drains.

Table 4-2. Diazinon Formulations Used in Orange County, 1999

Formulation	Use (lbs. ai)	Percent
Emulsifiable concentrate	14,776	60.4%
Granular/Flake	4,675	19.1
Wettable Powder	2,720	11.1
Flowable Concentration	1,969	8.1
Liquid Concentration	275	1.1
Dust/Powder	36.8	0.2
Pressurized Liquid/Sprays/Foggers	0.465	<0.5
Solution/Liquid (Ready to use)	0.184	<0.5
Total	24,452	100%

Source: CDPR Pesticide Use Report Database (CDPR 2000)

ai =active ingredient

Regardless of the formulation used, runoff is likely to occur only after significant rainfall or irrigation. Aside from runoff, a potentially significant discharge could occur through improper disposal of old or leftover material. The degree of knowledge concerning proper disposal varies considerably and it is unlikely that homeowners apply the exact amount needed in a manner that does not cause runoff.

Large-scale aerial spray applications may drift and result in significant offsite migration. These are generally applied to orchard crops in the Central Valley and, as Table 4-2 shows, they are not a significant application in Orange County.

There is evidence that the amount of diazinon in a watershed that reaches a receiving waterbody is generally less than one percent of that applied (Scanlin and Feng 1997). Thus, relatively limited instances of improper use (e.g. inappropriate disposal, excess outdoor application) could account for a large portion of the observed concentrations in the drainage channels.

Chlorpyrifos

Compared to diazinon, chlorpyrifos has a shorter half-life in water, but a longer half-life in soil. This is due in part to its higher adsorption coefficient, which results in chlorpyrifos partitioning out of the aquatic phase as it is bound by sediment and soil.

Table 4-3 shows the chlorpyrifos formulations used in Orange County in 1999. As with diazinon, concentrates, powders, and granular/flake formulations account for over 99% of the uses. These formulations require mixing/preparation prior to use.

Table 4-3. Chlorpyrifos Formulations used in Orange County, 1999

Formulation	Use (lbs. ai)	Percent
Emulsifiable concentrate	70,067	87.6%
Granular/Flake	6571	8.2
Wettable Powder	2281	2.9
Flowable Concentration	996	1.2
Liquid Concentration	38.1	<0.5
Dust/Powder	35.1	<0.5
Pressurized Liquid/Sprays/Foggers	1.58	<0.5
Solution/Liquid (Ready to use)	0.103	<0.5
Total	79,990	100%

Source: CDPR Pesticide Use Report Database (CDPR 2000)

ai =active ingredient

Of the top four formulations used in Orange County, only the granular/flake formulation would act to slowly release the active ingredient into the water, while the other formulations would enhance mobility. The lower release rate would result in lower concentrations over time.

Dissipation of chlorpyrifos from water takes place through sorption, volatilization, and photolysis. Chemical breakdown (hydrolysis) rates increase with increasing temperature and pH. Adsorbed chlorpyrifos is subject to degradation by UV light, chemical hydrolysis, and biodegradation.

4.2 Pesticide Usage

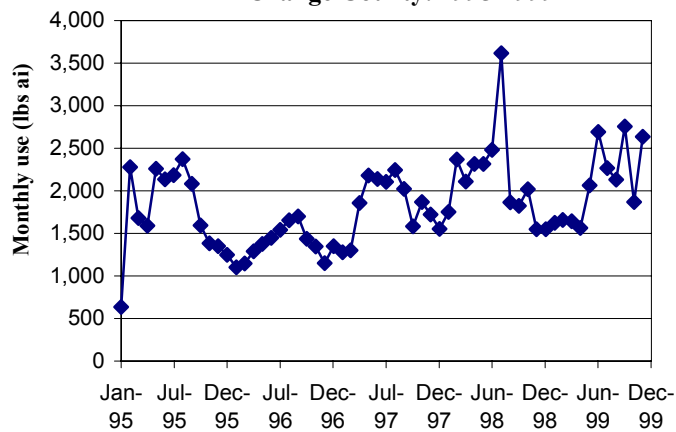
The CDPR requires records of all pesticide applications except for residential use by homeowners. These records are compiled and reported on a county-by-county basis. The Newport Bay watershed occupies 20% of Orange County, and it is assumed here that 20% of the pesticide use reported for Orange County occurred within the Newport Bay watershed.

Diazinon

As shown in Figure 4-1, reported diazinon use in Orange County has remained fairly steady over the past five years. Seasonally correlated increases in diazinon use are apparent in the summer months in response to increased pest activity.

As noted above, residential use by homeowners is not reported in the CDPR database. Information on national pesticide usage by homeowners is available from the USEPA Pesticide Industry Sales and Usage Market Estimates report. On a national basis, 75% of the diazinon used in the US each year is for non-agricultural purposes, with 39% used by homeowners outdoors and 3% used by homeowners indoors (USEPA 1999b). Total homeowner use is therefore about 42% on a national basis.

**Figure 4-1: Reported Diazinon Use
Orange County: 1995-1999**



In Orange County, the total agricultural use is likely less than the national average due to urbanization of the watershed. Thus, homeowner uses probably account for more than the 42% reported nationally. A more specific estimate of the unreported homeowner use can be obtained by assuming the national ratio of homeowner use to total non-agricultural use (42/75, or 56%) is applicable to Orange County. Since data on the total non-agricultural diazinon use in Orange County is reported to the CDPR on a yearly basis, the national ratio can be used to estimate the unreported homeowner use in Orange County. Estimating the unreported homeowner use at 56% of total non-agricultural use results in a figure of 29,119 lbs. active ingredient (ai) for 1999. This would amount to 54% of total use (including agricultural use) in Orange County; somewhat higher than the national figure of 42% reported by USEPA.

Tables 4-4 and 4-5 present the reported and estimated unreported diazinon use in Orange County. For 1999, the total diazinon use in the Newport Bay watershed would be one-fifth of the Orange County total, or approximately 10,714 lbs. ai, while the estimated residential use would be about 5,824 lbs. ai.

Table 4-5 indicates that urban uses accounted for over 97% of diazinon use, while agricultural uses (including nurseries) accounted for the remainder. Data from the Sales and Use Survey in the Newport Bay watershed (Wilen 2001) indicate that unreported residential diazinon use in 2000 was about 7,864 lbs. ai; about 32% larger than the estimate of 5,824 lbs. presented above using separate national data. This would suggest that total urban uses account for more than the 97% indicated in Table 4-5.

**Table 4-4: Reported and Estimated Diazinon Use
Orange County: 1995-1999 (lbs. ai)**

Use	1995	1996	1997	1998	1999
Structural	17,463	14,046	18,892	23,076	22,085
Nursery	1,037	839	803	1,212	1,144
Agriculture	2,004	746	1,363	865	429
Landscape	1,030	762	595	612	789
Other non-residential	9.8	46.2	1.6	1.7	5.3
Reported subtotal	21,543	16,439	21,655	25,766	24,452
Estimated Unreported Residential Use	23,548	18,905	24,804	30,150	29,119
Total	45,092	35,344	46,458	55,915	53,571

ai = active ingredient

Tables 4-4 and 4-5 show a decline in agriculture use from 1995 to 1999, both in absolute and percentage terms. The land use data also show a similar pattern, and the decline in agricultural diazinon usage may be a reflection of the continuing conversion of agricultural land to urban uses in Orange County and the Newport Bay watershed.

**Table 4-5: Reported and Estimated Diazinon Use
Orange County: 1995-1999 (percent)**

Use	1995	1996	1997	1998	1999
Structural	38.7%	39.7%	40.7%	41.3%	41.2%
Nursery	2.3%	2.4%	1.7%	2.2%	2.1%
Agriculture	4.4%	2.1%	2.9%	1.5%	0.8%
Landscape	2.3%	2.2%	1.3%	1.1%	1.5%
Other non-residential	0.0%	0.1%	0.0%	0.0%	0.0%
Estimated Residential	52%	53%	53%	54%	54%
Total	100%	100%	100%	100%	100%

USEPA Phaseout of Certain Diazinon Uses

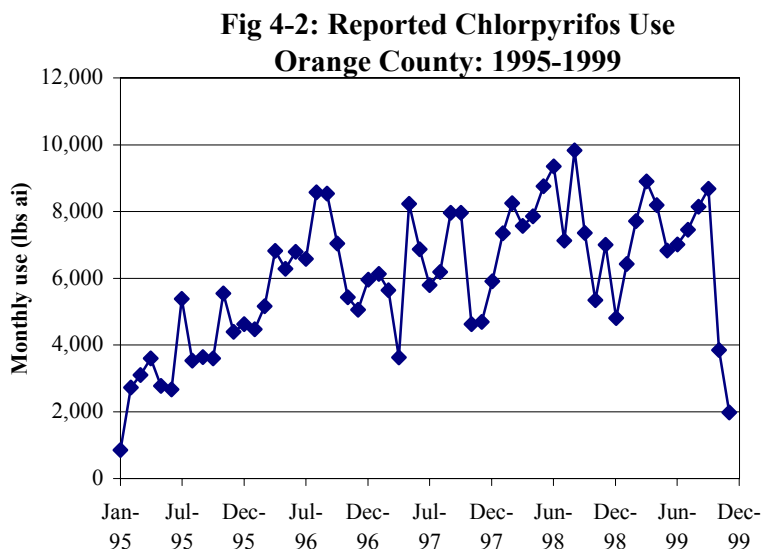
In January 2001, USEPA released a revised risk assessment and an agreement with registrants to phase out most diazinon uses (USEPA 2001). Under the agreement, all indoor uses will be terminated, and all outdoor non-agricultural uses will be phased out over the next few years. Indoor uses will be banned after December 31, 2002. The EPA expects that these actions will end about 75% of the current use of diazinon. In addition, on a national basis, about one-third of the agricultural crop uses will be removed. For the San Diego Creek/Newport Bay watershed, the percentage reduction in agricultural usage will be higher (ca. 55%) due to the particular crops that are grown in the watershed.

The usage data in Table 4-5 show that non-agricultural and non-nursery uses account for over 90% of the diazinon use in Orange County. It is thus likely that the EPA agreement will result in the cessation of most diazinon use in the Newport Bay watershed soon after the outdoor non-

agricultural use registration expires on December 31, 2004. Use of diazinon in the RIFA program is considered a public health use and will not be affected by the USEPA re-registration.

Chlorpyrifos

Figure 4-2 shows the reported chlorpyrifos use in Orange County from 1995 to 1999. As with diazinon, higher use tends to occur in the dry season, and is likely correlated with increased pest activity during warmer weather. An increasing trend from 1995 to 1998 is apparent followed by a sharp drop in 1999. This drop may be due to the agreement between EPA and the manufacturers to begin phasing out certain uses of chlorpyrifos (see below).



Tables 4-6 and 4-7 show the reported and estimated unreported chlorpyrifos use in Orange County. While overall chlorpyrifos use declined in 1999, nursery use increased by 300 percent. The significant increase in chlorpyrifos use by nurseries is likely due to the requirements imposed by the CDFA under the Red Imported Fire Ant (RIFA) program. Runoff of the solution from the treatment area is not permitted (CDFA 1999).

**Table 4-6: Reported and Estimated Chlorpyrifos Use
Orange County: 1995-1999 (lbs. ai)**

Use	1995	1996	1997	1998	1999
Structural	38,263	72,174	69,865	88,985	74,904
Nursery	652	772	971	994	2,913
Agriculture	1,414	952	1,450	645	1,132
Landscape	1,446	1,230	1,374	1,082	1,005
Other non-residential	7	268.5	1.6	1.6	35.3
Reported subtotal	41,782	75,396	73,662	91,707	79,990
Estimated Residential	21,663	40,185	38,859	49,128	41,424
Total	63,445	115,580	112,520	140,835	121,414

ai = active ingredient

Unreported (residential) chlorpyrifos use can be estimated by determining the national ratio of unreported home use to licensed (non-agricultural) use as reported in the USEPA Market Estimates Report (USEPA 1999b). Nationally, in 1995/96, the residential use was estimated at 2-4 million lbs. ai, while the licensed (non-agricultural) use was estimated at 4-7 million lbs. ai. Using the midpoints of these ranges, the ratio of residential use to licensed non-agricultural use

is 0.545 on a national basis. Applying this ratio to the licensed non-agricultural use in Orange County reported to the CDPR for 1999 (75,944 lbs. ai) yields an estimate of 41,424 lbs. ai unreported residential use (Table 4-6). This indicates that the unreported residential use was roughly 34% of the total use in 1999 (Table 4-7). Total chlorpyrifos use in the Newport Bay watershed for 1999 would be approximately 24,300 lbs. ai (one-fifth of the Orange County total).

Data from the Sales and Use Survey (Wilén 2001) indicates that retail sales of chlorpyrifos in the Newport Bay watershed may have declined to as little as 546 lbs. ai on an annual basis in 2000. This compares to the estimated residential use of 8,285 lbs. ai (one-fifth of the Orange County total) presented in Table 4-6 for 1999. The decline in chlorpyrifos use appears to be a continuation of the trend shown in Figure 4-2 toward the end of 1999, and is likely related to the re-registration agreement for chlorpyrifos (see below).

**Table 4-7: Reported and Estimated Chlorpyrifos Use
Orange County: 1995-1999 (percent)**

Use	1995	1996	1997	1998	1999
Structural	59.2%	61.9%	61.3%	62.7%	60.6%
Nursery	1.0%	0.7%	0.9%	0.7%	2.4%
Agriculture	2.2%	0.8%	1.3%	0.5%	0.9%
Landscape	2.2%	1.1%	1.2%	0.8%	0.8%
Other non-residential	0.0%	0.2%	0.0%	0.0%	0.0%
Reported subtotal	66%	65%	65%	65%	66%
Estimated Unreported Residential Use	34%	35%	35%	35%	34%
Total	100%	100%	100%	100%	100%

An analysis of chlorpyrifos sales data provided by Dow AgroSciences indicates that treatment for wood protection accounts for 70% of urban use (Giesy et al. 1998). Typical applications involve subsurface injection of chlorpyrifos at relatively high concentrations. Another 14% of urban use was categorized as home use (indoor pests, pet collars, lawns and gardens, building foundations, and other structural applications), while non-residential turf applications accounted for 7% of urban use.

USEPA Phaseout of Certain Chlorpyrifos Uses

In June 2000, the EPA published its revised risk assessment and agreement with registrants for chlorpyrifos (USEPA 2000a). The agreement imposes new restrictions on chlorpyrifos use in agriculture, cancels or phases out nearly all indoor and outdoor residential uses, and also cancels non-residential uses where children may be exposed. Application rates for non-residential areas where children will not be exposed (golf courses, road medians, industrial plant sites) will be reduced. Public health use for fire ant eradication and mosquito control will be restricted to professionals. Non-structural wood treatments will continue at current rates. Since the EPA estimates that about 50% of the chlorpyrifos use (both licensed and unreported) takes place at residential sites, the agreement is likely to result in at least a 50% decrease in chlorpyrifos use.

In Orange County, residential use (reported and unreported) likely accounts for over 90% of total chlorpyrifos use (most of the reported use is for structural protection applied in and around

homes). Thus, it appears that over 90% of the current chlorpyrifos use in the Newport Bay watershed will be eliminated by the EPA agreement. Retail sales are scheduled to stop by December 31, 2001, and structural uses will be phased out by December 31, 2005. Use of chlorpyrifos in the RIFA program is considered a public health use and will not be affected by the USEPA re-registration.

As noted above, the CDPR data, and the Sales and Use Survey data (Wilen 2001) indicate that chlorpyrifos use has been declining sharply within the last two years. This is likely due to the warning from EPA that retailers should not purchase stock unless they were able to sell it by December 31, 2001. A survey conducted in northern California in late 2000 noted, "Chlorpyrifos products have become increasingly difficult to find" (TDC Environmental 2001). It should be noted that the available water-quality data for the Newport Bay watershed, is largely from 1996-2000, and not directly correlated to the latest usage data from 2000-2001.

4.3 Data Summary and Analysis

This section presents an analysis of the sources of diazinon and chlorpyrifos in the Newport Bay Watershed. Each chemical summary includes monitoring data and a discussion of diazinon and chlorpyrifos sources categorized by land use. Point sources and non-point sources are also discussed in a separate section.

Diazinon Data Summary

Table 4-8 summarizes the results of diazinon sampling in the Newport Bay watershed. The sampling programs are described in Section 2. The table shows the high diazinon detection frequency, particularly during stormflow. The observed diazinon concentrations are similar to those observed in urban watersheds elsewhere in California. The mean values for both baseflow and stormflow exceeded the chronic numeric target, while 86% of the diazinon concentrations observed in the watershed drainage channels exceeded the acute numeric target.

Table 4-8. Summary of Diazinon Sampling Results

Source	Count	No. of Detects	Detection Frequency	Min.	Max.	Mean	Median
<i>Water Samples (ng/L)</i>							
Drainage Channels (All Flows)	198	185	93%	<40	10,000	471	220
Baseflow	104	93	89%	<40	10,000	473	160
Stormflow	94	92	98%	<50	7990	451	357
Upper Newport Bay	26	26	100%	197	720	386	357
Rainfall	1	1	--	--	13	--	--
<i>Sediment Samples (µg/kg)</i>							
Drainage Channels	98	2	2%	<10	49	--	--
Newport Bay	64	2	3%	<0.4	60	--	--

Freshwater Numeric Targets: acute = 80 ng/L; chronic = 50 ng/L (CDFG 2000a)

For comparison, the median diazinon concentration in the Santa Ana River downstream of Prado dam was 100 ng/L (USGS 2000), and the detection frequency was 99% (72 of 73 samples). The

USGS also reported stormflow concentrations as significantly elevated relative to baseflow concentrations.

The low detection frequency for the sediment samples is in accordance with the moderately low diazinon adsorption coefficient, and its relatively high solubility. All the sediment detections were reported from samples collected in 1994, and diazinon has not been detected in subsequent semi-annual sediment sampling.

Table 4-9 presents the data summarized by waterbody group. Highest concentrations occur in the upstream tributary channels to San Diego Creek. The maximum concentrations collected in 1998 from Hines Channel (which drains to Peters Canyon Channel) were three baseflow samples with concentration ranging from 2,500 to 10,000 ng/L. The maximum concentration of six baseflow samples collected in Hines channel during 2000 was 323 ng/L, indicating either a decrease in usage or more effective runoff control.

Table 4-9: Diazinon Results by Waterbody Group

Waterbody	Count	Results (ng/L)				Exceedances	
		Min	Max	Mean	Median	Above acute	Above chronic
Tributaries to SDC Reach 2	24	40	7,990	817	256	96%	92%
Tributaries to SDC Reach 1	21	49	628	226	134	86%	67%
Tributaries to PCC	41	40	10,000	791	271	83%	78%
Peters Canyon Channel	15	170	820	390	367	100%	100%
SDC Reach 1	59	50	960	301	215	95%	92%
Tributaries to UNB	35	40	2,250	357	202	94%	91%

SDC=San Diego Creek; PCC=Peters Canyon Channel; UNB=Upper Newport Bay

Freshwater Numeric Targets: acute = 80 ng/L; chronic = 50 ng/L

The similarity in median concentrations indicates that there are no clearly dominant areas of the watershed with regard to diazinon loading to San Diego Creek and Upper Newport Bay. Concentrations in Peters Canyon Channel are somewhat elevated relative to the other segments of the drainage network. This was also a conclusion of the 319h study (Lee and Taylor 2001)

San Diego Creek Reach 2: There were no sampling stations within Reach 2 of San Diego Creek. However, 24 samples were collected from tributary channels (Bee Canyon and Marshburn Slough). These samples were collected several miles upstream of where these channels join San Diego Creek and were mainly targeted at monitoring nursery discharges. The median concentration for these samples was 256 ng/L, with maximum concentrations of 7,990 ng/L during stormflow and 2,320 ng/L during baseflow. Over 90% of the observed concentrations exceeded the acute and chronic numeric targets.

San Diego Creek Reach 1: The main tributary to San Diego Creek Reach 1, aside from Reach 2, is Peters Canyon Channel. Median diazinon concentrations in Peters Canyon Channel (367 ng/L) were higher than in San Diego Creek (208 ng/L). The median concentration for other tributaries to San Diego Creek was 143 ng/L. All 15 samples collected within Peters Canyon Channel exceeded both the acute and chronic numeric targets, while in the tributaries to Peters Canyon

Channel, the percentages exceeding the acute and chronic numeric targets were lower, 78% and 83% respectively. Over 90% of the observed concentrations within Reach 1 exceeded the acute and chronic numeric targets.

Upper Newport Bay: The median concentration for drainage channels discharging directly to Upper Newport Bay (East Costa Mesa/Westcliff Park, Santa Ana Delhi) was 202 ng/L. The CDFG has not recommended criteria for diazinon in saltwater, however, the LC-50 for the commonly used test species (*Mysidopsis bahia*) is 4,200 ng/L, and the observed diazinon concentrations were all below this level, with a maximum of 720 ng/L. The USEPA (2000a) has published draft recommended acute and chronic criteria for diazinon in saltwater (820 ng/L and 400 ng/L respectively). The maximum and average results from Upper Newport Bay were below the respective draft USEPA saltwater CMC and CCC.

Diazinon Sources Categorized by Land Use

Tables 4-10a and 4-10b present the diazinon results by sampling location for storm and baseflow conditions, respectively, along with the primary land use in the monitored sub-watershed. Because of the difficulty in isolating and sampling small drainages for very specific land uses (such as the categories shown in Table 1-1) only broad land use categories are shown in Table 4-10a. The results are sorted by sampling location, moving from the upper part of the watershed to upper Newport Bay (Figure 4-3). Several of the locations were sampled during only baseflow or only stormflow conditions.

**Table 4-10a: Land Use and Diazinon Stormflow Concentrations
Newport Bay Watershed: 1996-2000**

ID	Station	Land Use	Count	Stormflow Results (ng/L)			
				Min	Max	Avg.	Median
S1	El Modeno Nursery	Nursery	7	126	7,990	1,625	599
S2	Hines Nursery	Nursery	9	199	810	455	324
S3	Marshburn Ch	Nursery/Ag	9	70	291	150	129
S4	Central Irvine Ch	Ag/Residential	2	280	810	545	545
S5	El Modeno-Irvine Ch	Urban	1	330	330	330	330
S6	Peters Canyon Ch	Mixed	11	202	520	339	330
S7	SDC-Harvard	Mixed	2	200	280	240	240
S8	San Joaquin Ch	Ag/Open	2	<50	<50	<50	<50
S9	SDC-Campus	Mixed	25	96	960	445	375
S10	Bonita Creek	Urban	7	69	628	424	456
S11	Santa Ana Delhi Ch	Urban	10	64	375	171	174
S12	E. Costa Mesa Ch	Urban	9	174	1,079	642	598

See Figure 4-3 for station locations, Ch = Channel, SDC=San Diego Creek

At virtually all the locations, the median stormflow concentration is significantly higher than the median baseflow concentration. Since stormwater runoff constitutes about 80% of the volume of water discharged to Newport Bay on an annual basis, this would indicate that the overwhelming majority of the pesticide load would derive from stormflow rather than baseflow. The average concentration is actually higher for baseflow, but this is biased by a few very high detections

from 1998 near nurseries. These results have not been observed in later sampling and the nurseries have subsequently instituted measures targeted at reducing pesticide runoff.

**Table 4-10b Land Use and Diazinon Baseflow Concentrations
Newport Bay Watershed: 1996-2000**

ID	Station	Land Use	Count	Stormflow Results (ng/L)			
				Min	Max	Avg.	Median
S1	El Modeno Nursery	Nursery	13	<40	2,320	580	131
S2	Hines Nursery	Nursery	15	<40	10,000	1,433	136
S3	Marshburn Ch	Nursery/Ag	1	<40	<40	<40	<40
S4	Central Irvine Ch	Ag/Residential	8	90	1,940	645	595
S5	El Modeno-Irvine Ch	Urban	1	180	180	180	180
S6	Peters Canyon Ch	Mixed	4	170	820	533	570
S7	SDC-Harvard	Mixed	2	<50	<50	<50	<50
S9	SDC-Campus	Mixed	30	<50	570	202	152
S10	Bonita Creek	Urban	12	49	332	139	114
S11	Santa Ana Delhi Ch	Urban	6	<50	340	149	125
S12	E. Costa Mesa Ch	Urban	10	<40	2,250	410	213

See Figure 4-3 for station locations, Ch = Channel, SDC=San Diego Creek

Although the sampling network is not detailed enough to identify individual sources (aside from nurseries), two conclusions are apparent:

- (1) Stormflow concentrations are virtually always higher than baseflow concentrations. This is particularly the case in the non-agricultural areas.
- (2) Urban areas tend to yield the highest stormwater runoff concentrations while the nursery areas tend to yield the higher baseflow concentrations.

Studies reported in the literature indicate that residential hotspots (individual homes) can account for most of the diazinon runoff from a neighborhood. Samples collected from the near vicinity of these residential hotspots (prior to dilution in the storm drain), showed concentrations above 10,000 ng/L (Scanlin and Feng 1997). Such detailed sampling and analysis for pesticides has not been completed in residential areas of the Newport Bay watershed. The residential run-off reduction study is currently in progress but results were not available for these TMDLs.

Chlorpyrifos Data Summary

Table 4-11 summarizes the chlorpyrifos results. The detection frequency is lower than for diazinon. This is due, in part, to the lower solubility of chlorpyrifos, and its greater affinity for sediment (Table 4-1). The lower mobility of chlorpyrifos results in lower concentrations in the drainage channels, despite the fact that over twice as much chlorpyrifos is applied as compared to diazinon (lbs. ai) (Tables 4-4 and 4-6),

The average values for stormflow and baseflow exceed the chronic numeric targets. Within the drainage channels, 44% of the chlorpyrifos results exceeded the freshwater chronic target (14

ng/L), while 92% of the samples collected in Upper Newport Bay were over the saltwater chronic target (9 ng/L).

Table 4-11. Summary of Chlorpyrifos Sampling Results

Source	Count	No. of Detects	Det. Freq	Min.	Max.	Mean	Median
<i>Water (ng/L)</i>							
Drainage Channels (All flows)	198	89	45%	ND	770	139	<50
Baseflow	104	36	35%	ND	670	162	<40
Stormflow	94	53	56%	ND	770	123	50
Upper Newport Bay	24	24	100%	2	132	43.3	41.5
Rainfall	1	1	--	--	23	--	--
<i>Sediment (µg/kg)</i>							
Drainage Channels	2	2	100%	17	29	--	--

Freshwater Numeric Targets: acute = 20 ng/L; chronic = 14 ng/L (CDFG 2000a)

Saltwater Numeric Targets: acute = 20 ng/L; chronic = 9 ng/L (CDFG 2000a)

The sediment data for chlorpyrifos is reflective of the higher soil adsorption coefficient relative to diazinon. Although chlorpyrifos analyses were not presented in the OCPFRD data, chlorpyrifos was detected in both sediment samples collected by the CDFG (2000b).

Table 4-12 presents the chlorpyrifos data summarized by waterbody group. Detection frequencies were low, particularly in the upper reaches of the watershed. Detection frequencies were higher in Peters Canyon Channel and its tributaries, where a large proportion of the samples were from undiluted nursery discharges. Comparison to the acute and chronic numeric targets is difficult because they are set at levels below the analytical reporting limit used for most of the sampling/monitoring programs. In Table 4-12, all detections exceeded the acute and chronic targets.

Table 4-12. Chlorpyrifos Results by Waterbody Group

Waterbody	Count	Results (ng/L)			Detection Frequency*
		Max	Mean	Median	
Tributaries to SDC Reach 2	24	121	51	<40	33%
Tributaries to SDC Reach 1	21	770	95	<40	10%
Tributaries to P CC	41	670	108	50	54%
Peters Canyon Channel	15	420	83	57	60%
SDC Reach 1	59	580	102	57	59%
Tributaries to UNB	35	231	47	<40	37%
Upper Newport Bay	24	132	43.3	41.5	100%

SDC = San Diego Creek; PCC = Peters Canyon Channel; UNB=Upper Newport Bay

** The reporting limit for chlorpyrifos in freshwater was above the acute and chronic numeric targets, therefore all detected concentrations in freshwater exceeded the numeric targets.*

San Diego Creek Reach 2: There were no samples collected from within Reach 2, however, samples collected from tributary channels discharging into Reach 2 had a low detection frequency (33%) and a maximum concentration of 121 ng/L.

San Diego Creek Reach 1: Samples collected from locations in Reach 1 of San Diego Creek (at Campus, Coronado, and Harvard streets) had a relatively high detection frequency and the highest median concentration, along with Peters Canyon Channel. This may indicate that the greater part of the chlorpyrifos loading is derived from Peters Canyon Channel and its sampled tributaries (Hines, Central Irvine). However, the maximum chlorpyrifos concentrations occurred in two samples collected from San Joaquin Creek, which discharges directly into Reach 1 of San Diego Creek.

Upper Newport Bay: Chlorpyrifos was detected in all samples collected in Upper Newport Bay, where a lower detection limit was employed. Eighty percent of the results exceeded the acute numeric target, while 92% exceeded the chronic numeric target. The samples were collected over several days during a storm event in January 1999. The chlorpyrifos concentration that saltwater organisms are exposed to is largely dependent on the degree of mixing between saltwater and freshwater in the upper bay. In the case of the storm sampled in January 1999, a freshwater lens persisted for several days in the upper bay. Chlorpyrifos concentrations were inversely correlated with salinity. Overall, the observed concentrations were lower in Upper Newport Bay than in San Diego Creek.

Chlorpyrifos Sources Categorized by Land Use

Tables 4-13a and 4-13b present the chlorpyrifos results by sampling location during storm and baseflow conditions, respectively, along with the primary land use in the monitored sub-watershed. The results are sorted by sampling location, moving from the upper part of the watershed to upper Newport Bay (Figure 4-3). Several of the locations were sampled during only baseflow or only stormflow conditions.

Stations sampling runoff derived from mixed land use areas tended to have the highest chlorpyrifos concentrations under both baseflow and stormflow conditions. A major exception was the data from San Joaquin Creek. This creek was sampled during two separate storm events in February 2000. (Baseflow samples were not collected). The results were the two highest chlorpyrifos concentrations (770 ng/L and 470 ng/L) in the entire dataset. This sample was also associated with very high concentrations of carbaryl that were determined to originate from agricultural fields planted with strawberries that were treated with pesticides immediately prior to a rainfall event.

Chlorpyrifos was not detected in the two stormflow samples collected at the second non-nursery agricultural location (Sand Canyon Ave - NE corner Irvine Blvd). Therefore, it appears prudent to avoid assigning a median concentration to the entire watershed for non-nursery agriculture based on this limited data set.

It is difficult to draw strong conclusions from the data in Tables C-13a and C-13b due to the limited number of samples at most of the locations, and the large number of non-detect results. The chlorpyrifos results also do not correlate well with the diazinon results; the locations with the higher diazinon concentrations do not generally yield the higher chlorpyrifos concentrations. The sampling locations at Westcliff Park and the Central Irvine Channel at Monroe were the only locations among the top seven stormflow results for both chlorpyrifos and diazinon. The

baseflow results had a somewhat better correlation, but overall the data suggest differing usage patterns for chlorpyrifos and diazinon.

Sample locations monitoring residential areas tended to have lower chlorpyrifos concentrations. Chlorpyrifos was not detected at three of the residential locations under either baseflow or stormflow conditions. The detection frequency, and maximum concentrations detected at another partly residential location (Santa Ana Delhi Channel) were low. The only residential site with relatively high chlorpyrifos concentrations was Westcliff Park (stormflow), but the baseflow concentrations were relatively low.

Although it appears that some of the nursery/agricultural locations yield higher chlorpyrifos concentrations than the residential areas, it should be noted that the nursery monitoring locations are selected to monitor undiluted nursery discharge, very close to where the chlorpyrifos is used. In contrast, runoff water quality data from individual homes or from distinct residential neighborhoods were not available. Rather, data were collected from drainage channels receiving mixed/diluted runoff from many residential neighborhoods. In addition, because of the relative immobility of chlorpyrifos, and its tendency to adsorb to sediment, higher chlorpyrifos concentrations are most likely to be encountered only near areas where it is applied, before it partitions out of the aqueous phase and settles out along with the sediment.

**Table 4-13a: Land Use and Chlorpyrifos Stormflow Concentrations
Newport Bay Watershed: 1996-2000**

ID	Station	Land Use	Count	Stormflow Results (ng/L)		
				Detections	Median	Max
S1	El Modeno Nursery	Nursery	7	14 %	<40	60
S2	Hines Nursery	Nursery	9	56 %	<50	349
S3	Marshburn Ch	Nursery/Ag	9	78 %	62	121
S4	Central Irvine Ch	Ag/Urban	2	100 %	110	150
S5	El Modeno-Irvine Ch	Urban	1	0 %	<50	<50
S6	Peters Canyon Ch	Mixed	11	64 %	80	150
S7	SDC-Harvard	Mixed	2	100 %	250	310
S8	San Joaquin Ch	Ag/Open	2	100 %	620	770
S9	SDC-Campus	Mixed	25	72 %	57	260
S10	Bonita Creek	Urban	7	0 %	<40	<40
S11	Santa Ana Delhi Ch	Urban	10	30 %	<50	55
S12	E. Costa Mesa Ch	Urban	9	67 %	63	231

See Figure 4-3 for station locations, Ch = Channel, SDC=San Diego Creek

**Table 4-13b: Land Use and Chlorpyrifos Baseflow Concentrations
Newport Bay Watershed: 1996-2000**

ID	Station	Land Use	Count	Stormflow Results (ng/L)		
				Detections	Median	Max
S1	El Modeno Nursery	Nursery	13	15 %	<40	57
S2	Hines Nursery	Nursery	15	53 %	<50	670
S3	Marshburn Ch	Nursery/Ag	1	0 %	<40	<40
S4	Central Irvine Ch	Ag/Urban	8	75 %	63	315
S5	El Modeno-Irvine Ch	Urban	1	0 %	<50	<50
S6	Peters Canyon Ch	Mixed	4	50 %	53.5	420
S7	SDC-Harvard	Mixed	2	50 %	225	400
S8	San Joaquin Ch	Ag/Open	0	---	---	---
S9	SDC-Campus	Mixed	30	47 %	<50	580
S10	Bonita Creek	Urban	12	0 %	<40	<40
S11	Santa Ana Delhi Ch	Urban	6	33 %	<50	18
S12	E. Costa Mesa Ch	Urban	10	20 %	<40	129

See Figure 4-3 for station locations, Ch = Channel, SDC=San Diego Creek

Note: S11 max less than median due to lower reporting limit for some samples

Point Sources

The Regional Board issues Waste Discharge Requirements (WDRs) and NPDES permits for discharges of waste to land and surface waters, respectively. There are thirteen individual waste discharge requirement (WDR) or NPDES permit holders in the Upper Newport Bay watershed. In addition, three general NPDES permits and an areawide municipal stormwater permit apply within the San Diego Creek/Newport Bay watershed.

NPDES

NPDES - Stormwater Runoff:

Stormwater and urban nuisance flows in that portion of Orange County within the Santa Ana Regional Board's jurisdiction (including the San Diego Creek/Newport Bay watershed) are regulated under an areawide municipal stormwater permit issued to Orange County and its co-permittees. As presented above, these flows are significant sources of diazinon and chlorpyrifos inputs to surface waters within the San Diego Creek/Newport Bay watershed. As discussed in Section 2, the OCPFRD monitoring program does not include analysis for organophosphate pesticides. However, considerable data have been collected from stormwater runoff channels as part of the 205j, 319h, and CDPR investigations.

NPDES – Extracted Groundwater:

Many NPDES regulated discharges within the San Diego Creek/Newport Bay Watershed consist of extracted groundwater resulting from dewatering activities or groundwater cleanup projects. The Regional Board has issued some individual permits for these discharges, but most are regulated under general NPDES permits. These discharges are not expected to be sources of diazinon and chlorpyrifos loads to the watershed (groundwater is discussed further below), and the dischargers are not required to monitor for organophosphate pesticides.

NPDES - Boatyard General Permit

Six boatyard operations in Newport Beach are enrolled under a general NPDES permit. Diazinon/chlorpyrifos usage at boatyards is not expected to differ significantly from general urban uses. The permit prohibits discharge of water to Newport Bay with the exception of stormwater runoff after the first 1/10th inch of precipitation. In short, the boatyards are not regarded as a significant source of organophosphate pesticide runoff.

NPDES - Other

Diazinon has been found in effluent from sewage treatment plants (USEPA 1999a). This may be due to improper disposal of surplus pesticides into sewer drains, or to indoor diazinon usage in urban areas (TDC Environmental 2001). There are no sewage treatment plants in the Newport Bay Watershed that discharge effluent to the drainage channels or Newport Bay.

The Newport Bay Watershed residential use survey indicated a lack of knowledge among homeowners concerning proper disposal procedures (Wilen 2001). This is reflected in the diazinon and chlorpyrifos monitoring data for receiving waters affected by storm and urban nuisance flows.

Waste Discharge Requirements:

Nursery Waste Discharge Requirements (WDR):

There are three commercial nurseries in the Newport Bay watershed that are regulated under WDRs. (While the nurseries discharge to surface waters, they and other agricultural operations are exempt from permitting under the NPDES program.) WDRs are being prepared for an additional two nurseries. Together, these nurseries account for less than two percent of the area in the Newport Bay Watershed. As part of the nutrient TMDL for Newport Bay (1999), nurseries greater than five acres and discharging to tributaries that enter Newport Bay were required to institute a regular monitoring program. The monitoring program includes bi-monthly monitoring for toxicity; however, diazinon and chlorpyrifos are not currently analyzed. Several of the sampling locations for the 205j, 319h and DPR-RIFA studies were chosen to monitor discharges from nurseries to the drainage channel network. The highest diazinon results occurred in sampling stations near the Hines and El Modeno nurseries.

Other WDRs:

Several other facilities (including one landfill) have WDRs but none are required to monitor for organophosphate pesticides, and they are not considered to be significant sources of diazinon and chlorpyrifos runoff.

Groundwater

Although there are no currently available groundwater data for diazinon and chlorpyrifos in the Newport Bay watershed, groundwater does not appear to be contributing diazinon and chlorpyrifos loads to the drainage system. Diazinon and chlorpyrifos concentrations are lower downstream of areas where groundwater seeps into the drainage channels. This indicates that the groundwater serves to dilute the concentrations.

In general, diazinon and chlorpyrifos tend to dissipate from the ground surface or in the upper soil layers before percolating to groundwater. Diazinon and chlorpyrifos have not been detected in groundwater sampling conducted by the USGS in the lower Santa Ana River Basin.

Sediment Remobilization

As discussed in the fate and transport section, diazinon has a relatively low potential to adsorb to sediment, while chlorpyrifos has a greater adsorption coefficient (Table 4-1). Chlorpyrifos could accumulate in sediment and be gradually released into the water through desorption. This would require stability of the adsorbed chlorpyrifos, but adsorbed chlorpyrifos is still subject to chemical hydrolysis and biodegradation.

The available sediment data demonstrate that diazinon is not being bound to sediment to a significant degree. As shown in Table 4-8, the detection frequency for diazinon in sediment samples is less than two percent.

Two sediment samples were collected by the CDFG in July/August 2000. Chlorpyrifos was detected in sediment from Hines channel (29 ng/g) and in sediment collected nine miles downstream from the nurseries in San Diego Creek (17 ng/g) (CDFG 2000b). Diazinon was not detected at either location (reporting limit of 10 ng/g dry weight)

As part of the semi-annual sampling program, the OCPFRD collected 96 sediment samples from the Newport Bay watershed and 54 sediment samples from the Bay itself from 1994-1999. Only four diazinon detections were reported. All the detections occurred in 1994, at concentrations of 40 µg/kg to 60 µg/kg. Reporting limits ranged from 35 µg/kg to 400 µg/kg. OCPFRD does not currently monitor sediment for chlorpyrifos.

Atmospheric Deposition

Diazinon is one of the most frequently detected pesticides in air, rain, and fog (USEPA 1999a). In sampling conducted in California in 1988, diazinon was detected in approximately 90% of the sites sampled. Chlorpyrifos has a vapor pressure in the same range as diazinon, and can be expected to volatilize from treated areas. It is not as commonly detected in the atmosphere however.

A rainwater sample collected in the Newport Bay watershed during the 205(j) studies (December 1997) was reported to have a diazinon concentration of 13 ng/L and a chlorpyrifos concentration of 23 ng/L (Lee and Taylor 1999). For comparison, eight rainwater samples collected in urban watersheds in the San Francisco Bay area, had a mean diazinon detected concentration of 58 ng/L with a maximum of concentration of 88 ng/L (Katznelson and Mumley 1997).

Higher diazinon concentrations in rainwater have been detected in agricultural areas (over 5,000 ng/L in 1994-95, and ranging from 418 ng/L to 5,463 ng/L in 14 cities located in the Central Valley), but these are likely related to aerial spray applications to orchards – a type of use that is negligible in the Newport Bay Watershed. Rainfall collected in the winter of 1992-93 in the San

Joaquin basin contained up to 1,900 ng/L diazinon, and is “presumed to be droplets from dormant spray applications (not volatilization from treated crops)” (Novartis 1997).

Assuming the measured rainfall concentration is representative for all storm events, and assuming no degradation during runoff, the annual diazinon load derived from rainfall would be approximately 0.7 lbs. This would be about 2% of the mean annual load at the SDC-Campus station. For chlorpyrifos, the load would be 1.3 lbs., or about 15% of the mean annual load.

It is uncertain whether this contribution is from volatilization from use within the watershed, or from aerial transport from sources outside the watershed. For estimating loads, the contribution from rainfall is already taken into account by the runoff sampling in the watershed. Direct deposition (rainfall falling directly into Upper Newport Bay) would be negligible since the area of the bay relative to the watershed is less than one percent. The diazinon load would be less than 0.0072 lbs., or less than 0.02% of the annual load to the Bay. For chlorpyrifos the load would be 0.0127 lbs. or about 0.15% of the total annual load.

4.4 Approach to Calculating Current Loads

This section presents calculations of estimated diazinon and chlorpyrifos loads to San Diego Creek and Upper Newport Bay. Because the TMDL is concentration based, the load information is presented for information purposes only and is not used as a basis for assigning allocations.

Mean annual loads were calculated using mean water column concentrations from the SDC-Campus station. Mean annual baseflow and stormflow volumes were calculated using the flow data for the SDC-Campus station. Baseflows are defined as flow rates less than or equal to 20 cfs at the SDC-Campus station. For the purposes of the diazinon and chlorpyrifos TMDL, stormflows are defined as flows greater than 20 cfs at the SDC-Campus station. Using these definitions, mean annual baseflow and stormflow volumes were calculated using 19 years of available flow data provided by the Orange County. Loads were then determined by multiplying the mean concentrations with the mean flows. As the SDC-Campus station represents over 95% of the flow in the watershed, loads were not calculated for the other tributaries.

Diazinon

The estimated mean annual diazinon load at the SDC-Campus station is about 32 lbs (Table 4-14). This amounts to about 0.3% of the estimated 10,800 lbs of diazinon (ai) used within the watershed in 1999. This finding is similar to the results of a recent study in the Castro Valley (urban) watershed. That study found that 0.3% of the applied diazinon (ai) was discharged into Castro Valley Creek, with 90% of the load delivered by storm runoff (Scanlin and Feng 1997).

**Table 4-14: Estimated Mean Annual Diazinon Load
San Diego Creek – Campus Station**

Flow	Mean Annual Flow (acre-feet)	Mean Conc. (ng/L)	Load (lbs.)	Load (%)
Base flow	6,323	200	3.43	10
Storm flow	26,950	445	32.6	90
Total	33,273	--	36.0	100

The intensive residential investigation in the Castro Valley Creek watershed (Scanlin and Feng 1997) revealed that a small number of individual residential hotspots (2% to 4% of the homes) produced the bulk of the diazinon loading to the Creek. Controlled experiments to evaluate diazinon runoff from individual homes demonstrated that even when diazinon was used properly, very high levels of diazinon would still be found in the runoff. Highest source areas were patios and driveways, followed by roof drains. These results are probably due to the lower rates of dissipation from these surfaces as compared to lawns or soil, where biodegradation would be much more significant.

Chlorpyrifos

Table 4-15 presents an estimate of the annual chlorpyrifos loading to San Diego Creek and Upper Newport Bay. The total annual mass of chlorpyrifos entering Upper Newport Bay is about 8 pounds. This is about 0.03% of the estimated 24,300 lbs. ai of chlorpyrifos applied in the watershed in 1999 (one-fifth of the Orange County total given in Table 4-6). This load is based on a conservative estimate of chlorpyrifos concentrations in tributaries to Upper Newport Bay. Actual concentrations in Upper Newport Bay would be reduced due to mixing and dilution.

**Table 4-15. Estimated Mean Annual Chlorpyrifos Load
San Diego Creek – Campus Station**

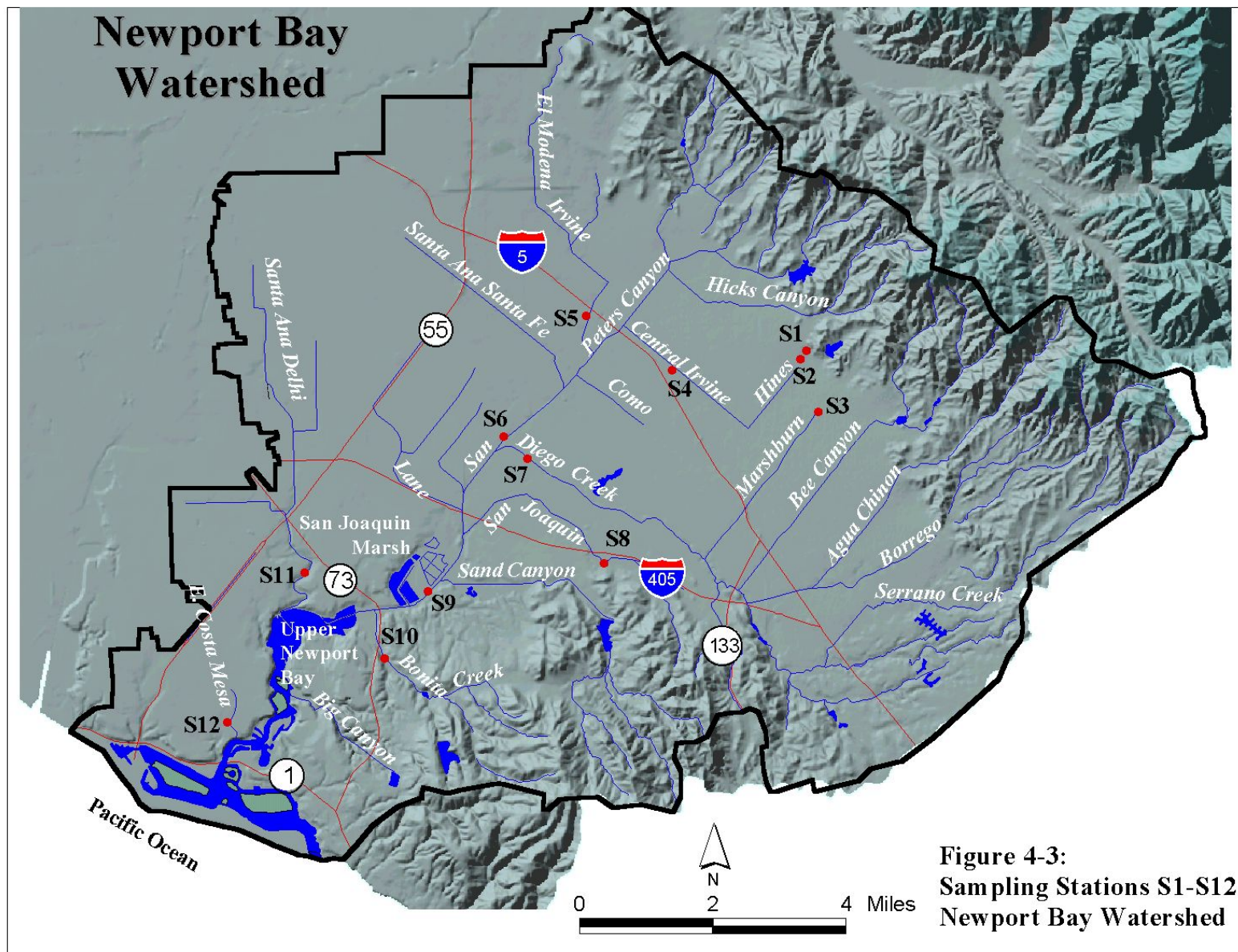
Flow	Annual Flow (acre-ft.)	Mean Conc. (ng/L)	Load (lbs.)	Load (%)
Baseflow	6,323	111	1.91	23
Stormflow	26,950	86.8	6.36	77
Total	33,273	--	8.27	100

4.5 Summary and Conclusions

The following conclusions are based on data collected in the Newport Bay watershed prior to implementation of EPA re-registration agreements for chlorpyrifos and diazinon:

- Reported and unreported urban uses account for over 90% of total chlorpyrifos and diazinon use in Orange County and in the Newport Bay Watershed.

- About 36 pounds of diazinon is discharged annually to San Diego Creek, mostly during storm events. This amounts to about 0.34% of the applied diazinon mass in the watershed. About 8 pounds of chlorpyrifos are annually discharged to Upper Newport Bay, with 77% of the load delivered during storm events. This amounts to about 0.03% of the applied chlorpyrifos mass.
- Surface runoff is the source of virtually all the loadings. Contributions from sediment remobilization and groundwater are negligible; however, loading from atmospheric deposition to Upper Newport Bay is potentially significant, though not well quantified.
- On a per acre basis, agricultural and urban land uses contribute diazinon and chlorpyrifos runoff at fairly equal rates within the watershed. Runoff derived from urban land uses accounts for about 88% of the diazinon baseflow load, and 96% of the stormflow load. Agricultural sources (including nurseries) account for the remainder of the load. For chlorpyrifos, runoff derived from urban land uses accounts for about 85% to 88% of the baseflow and stormflow loads, while agriculture (including nurseries) accounts for about 12% to 15% of the load.
- Average diazinon concentrations in San Diego Creek exceeded the chronic numeric target, and 95% of the observed concentrations were also above the acute numeric target.
- Average chlorpyrifos concentrations in San Diego Creek exceeded the chronic numeric target, and at least 59% of the observed concentrations exceeded the acute numeric target. The average chlorpyrifos concentration observed in Upper Newport Bay during a storm event exceeded the saltwater chronic numeric target, and 80% of the concentrations exceeded the acute numeric target.
- The diazinon re-registration agreement by EPA will likely end over 90% of current diazinon use in the Newport Bay watershed. If runoff concentrations show a corresponding decline, diazinon concentrations in San Diego Creek could decrease below the chronic numeric target (50 ng/L).
- The chlorpyrifos re-registration agreement by EPA will likely end over 90% of current chlorpyrifos use in the Newport Bay watershed. If runoff concentrations show a corresponding decline, chlorpyrifos concentrations in San Diego Creek and Upper Newport Bay could decline below the respective chronic numeric targets for freshwater and saltwater.



5.0 LOADING CAPACITY/LINKAGE ANALYSIS

The diazinon and chlorpyrifos TMDL uses a concentration-based loading capacity and allocations for diazinon and chlorpyrifos. The concentration-based loading capacity will address the problems of aquatic toxicity within the watershed and Upper Newport Bay. These concentration-based TMDLs will protect aquatic life from short-term exposure via acute targets and long-term exposure via chronic targets.

The concentration-based loading capacity values are exactly the same as those selected as the numeric targets (see Table 3-1). For San Diego Creek, the loading capacity for diazinon has two components: the chronic or 4-day average concentration (50 ng/L), and a maximum 1-hour average (acute) concentration of 80 ng/L. The loading capacity for chlorpyrifos in San Diego Creek also has two components: the chronic or 4-day average concentration (14 ng/L), with a maximum 1-hour average (acute) concentration of 20 ng/L. For Upper Newport Bay, the loading capacity for chlorpyrifos has two components: the chronic or 4-day average concentration (9 ng/L), and a maximum 1-hour average (acute) concentration of 20 ng/L acute.

As discussed above regarding the numeric targets, this loading capacity (including the margin of safety discussed below) will result in achievement of the second narrative water quality objective for toxic substances (that concentrations of toxic substances shall not adversely affect beneficial uses) because these numeric targets arise directly from relevant aquatic toxicity tests.

6.0 TMDL AND ALLOCATIONS

The TMDL for diazinon and chlorpyrifos is being established at levels equivalent to the loading capacities identified above. Concentration-based allocations are also being used for both wasteload allocations (WLA) and load allocations (LA). The WLA applies to point sources in the watershed regulated under NPDES permits or Waste Discharge Requirements. The LA applies to non-point sources such as agriculture, open space and atmospheric deposition.

For its diazinon/chlorpyrifos TMDL, USEPA established an explicit (10%) margin of safety (discussed below); therefore, the concentration-based allocations were calculated as 90% of the numeric target level for each pesticide under acute and chronic exposure conditions. For example, the numeric target for diazinon under acute conditions is 80 ng/L. The wasteload and load allocations are set at 72 ng/L, after subtraction of 8 ng/L to provide the 10% margin of safety. This explicit margin of safety approach is included in this TMDL.

Allocations for Freshwater Water Bodies

Table 6-1 presents the concentration-based freshwater allocations for chlorpyrifos and diazinon; these apply to all point sources (wasteload allocations) and to all non-point sources (load allocations). The diazinon allocations apply to freshwater discharges into San Diego Creek Reach 1 and Reach 2. The chlorpyrifos allocations apply to freshwater discharges into San Diego Creek (Reach 1 and Reach 2) and freshwater discharges into Upper Newport Bay including Santa Ana Delhi Channel, East Costa Mesa Channel and other drainages to the Upper Bay. This includes discharges from agricultural and residential lands, including flows from the storm water systems. These limits apply regardless of season and flow; i.e., at all times of the year.

Table 6-1: Diazinon and Chlorpyrifos Allocations for San Diego Creek

Category	Diazinon (ng/L)		Chlorpyrifos (ng/L)	
	Acute	Chronic	Acute	Chronic
Wasteload Allocation	72	45	18	12.6
Load allocation	72	45	18	12.6
MOS	8	5	2	1.4
TMDL	80	50	20	14

MOS = Margin of Safety

Chronic means 4-consecutive day average

Allocations for Upper Newport Bay

Table 6-2 presents the saltwater allocations for chlorpyrifos; these apply to all point sources (wasteload allocations) and to all non-point sources (load allocations). It applies to saltwater allocations in Upper Newport Bay, defined from San Diego Creek at Jamboree Rd. down to Pacific Coast Highway Bridge. These limits apply regardless of season and flow; i.e., at all times of the year.

Table 6-2. Chlorpyrifos Allocations for Upper Newport Bay

Category	Acute (ng/L)	Chronic (ng/L)
Wasteload allocation	18	8.1
Load allocation	18	8.1
MOS	2.0	0.9
TMDL	20	9

MOS = Margin of Safety

Chronic means 4-consecutive day average

Needed Reductions

Table 6-3 summarizes the estimated needed concentration-based (load) reductions for diazinon and chlorpyrifos in order to achieve the TMDL numeric targets in San Diego Creek. Multiple samples are available from five separate storm events in the watershed from 1997-2000. The storm average concentrations in Table 6-3 are the maximum single storm averages at the San Diego Creek-Campus station. The difference between the current load and the allocation is the needed reduction. Chlorpyrifos concentrations may have begun to decline in 2000 and 2001, based on indications of a reduction in usage from the DPR database as well as from the Sales and Use Survey (Wilén 2001) conducted in late 2000. To date, there are no clear indications of declining trends in diazinon usage in the watershed. This table indicates the estimated needed reduction during average storm flows. As discussed above, the majority of the pesticide load derives from stormflow.

Table 6-3. Needed Load (concentration based) Reductions for San Diego Creek.

Constituent	San Diego Creek Campus Station		Allocation		Needed Reduction	
	Storm Average (ng/L)	Max (ng/L)	Chronic (ng/L)	Acute (ng/L)	Chronic	Acute
Chlorpyrifos	120	580	12.6	18	90%	97%
Diazinon	848	960	45	72	95%	93%

Chronic means 4-consecutive day average

Although the estimated reductions in Table 6-3 are very steep, the USEPA re-registration agreements discussed in Section 4.2 should result in significant declines in diazinon and chlorpyrifos use, and the resulting discharge concentrations to San Diego Creek and Upper Newport Bay. However, additional measures may be necessary to achieve the reductions set forth above.

7.0 SEASONAL VARIATION/CRITICAL CONDITIONS

Pesticide usage correlates roughly with the season, with increasing usage in the warmer months due to increased pest activity. However, runoff into the drainage channels is greatest during the wet season, and higher pesticide concentrations are observed during storm events. The higher pesticide concentrations primarily account for the toxicity observed in stormwater samples collected in the watershed. The chronic criteria used as the basis for the numeric targets are designed to ensure protection of aquatic life during all stages of life, including the most sensitive stages. Because the TMDL is being expressed as a concentration, a detailed analysis of critical conditions is unnecessary. The concentration-based allocations (Table 6-1 and 6-2) will apply and be protective during all flow conditions and seasons.

8.0 MARGIN OF SAFETY

An explicit 10% margin of safety was applied to the recommended criteria derived by the CDFG (2000a) and EPA (1986) for diazinon and chlorpyrifos. This explicit margin of safety is intended to account for uncertainties in TMDL calculation methods and concerning pesticide effects (e.g., potential additive and synergistic impacts from exposure to multiple organophosphate pesticides) that may aggravate water quality impacts due to diazinon and chlorpyrifos usage in the watershed.

In addition to the explicit margin of safety, conservative assumptions were used in applying the numeric targets within the watershed. These conservative assumptions serve as implicit margins of safety to provide additional protection for aquatic life and minimize aquatic toxicity.

1. No adjustment was made to reflect the possibility of pesticide breakdown from point of discharge to San Diego Creek. Scientists have measured that half-lives of diazinon and chlorpyrifos in water range from a few days up to six months, therefore some degradation is likely to be occurring after application and within flowing waters. Assuming discharges are within the specified concentration-based allocations, and that such degradation (via biotic and abiotic processes) occurs, there will be sufficient protection for aquatic life.
2. No adjustment was made to reflect the possibility of mixing and dilution within the drainage channels. In particular, the dilution capacity provided by groundwater seepage has not been factored into the TMDLs.

9.0 DRAFT IMPLEMENTATION PLAN

9.1 INTRODUCTION

Federal law requires that TMDLs be incorporated into the state water quality management plan (Basin Plan) upon USEPA approval. California law requires that Basin Plans have a program of implementation to achieve water quality objectives. The implementation program must include a description of actions necessary to achieve the objectives, a time schedule for these actions, and a description of surveillance to determine compliance with the objectives.

A TMDL does not establish new water quality objectives. A TMDL is intended to achieve existing narrative or numeric water quality objectives. An implementation plan must be developed to ensure that the TMDL achieves its purpose.

This implementation plan details the activities planned to ensure that the TMDL is achieved. The TMDL implementation tasks and schedule are presented in Section 9.2, while Sections 9.3 and 9.4 provide a brief economic analysis and identify potential funding sources.

The remainder of this introduction provides an overview of water quality studies underway in the Newport Bay watershed that may be relevant for implementation of the TMDL.

Relevant Studies In The Watershed

The toxics TMDLs adopted by the U.S. EPA follow adoption of the nutrient (1998), sediment (1998), and pathogen (1999) TMDLs for the Newport Bay watershed. A number of investigations and monitoring programs have been established in conjunction with the existing TMDLs. Some of the studies that may be relevant for implementation of this TMDL are listed below.

1. Residential Runoff Reduction Study. The objective of this study is to quantify the water quantity savings and water quality benefits from installation of advanced landscape irrigation controllers in individual residences. Over one year of diazinon and chlorpyrifos data from five separate neighborhoods is being collected. Upon completion in December 2002, this project should provide detailed information on pesticide export rates, and the effectiveness of education in reducing pesticide runoff.
2. Evaluation of Urban BMPs for Nutrients. This Proposition 13 project is being undertaken by Orange County in conjunction with the nutrient TMDL. The project will test the effectiveness of urban BMPs for nutrient load reductions, but it could also be broadened to include pesticides.
3. Agricultural BMPs for Nutrients. UC Riverside and the UC Cooperative extension office in Irvine are managing this project, which was initiated as part of the implementation plan for the nutrient TMDL. BMPs that are effective for nutrients may also be useful in reducing pesticide runoff.

4. CDPR RIFA Monitoring. The RIFA quarantine area includes the nurseries in the watershed. The RIFA program requires use of pesticides, and these pesticides may include diazinon and chlorpyrifos. Use of diazinon and chlorpyrifos in the RIFA program is considered a public health use and will not be affected by the USEPA re-registration agreements. As described in Section 2.0, the CDPR is monitoring RIFA pesticides in nursery runoff
5. Pest Management Alliance for the Containerized Nursery Industry. In 1999 and 2000, the CDPR funded work by the UC Cooperative Extension and the UC-Riverside Department of Entomology to evaluate pest management practices in the containerized nursery industry of California. The project surveyed existing practices and suggested that alternative methods to reduce pesticide use were available.

9.2 IMPLEMENTATION TASKS

Table 9-1 shows the planned tasks and schedule for implementation of the TMDL. These tasks are discussed in more detail in the following subsections. The USEPA re-registration agreements, while not tasks under the jurisdiction of the Regional Board, are included here due to their anticipated significance in reducing diazinon and chlorpyrifos use in the watershed. The Regional Board will verify implementation of the re-registration agreements through review of CDPR's pesticide use report database, and through analysis of monitoring data.

Table 9-1. TMDL Task Schedule

Task No.	Task	Schedule	Description
1	USEPA Re-registration agreements	12/2001 to 12/2006	Phase-out of uses specified in the re-registration agreements. Should end over 90% of usage.
2	Revise Discharge Permits	2005	WDR and NPDES permits will be revised to include the TMDL allocations, as appropriate.
3	Pesticide Runoff Management Plan	2004	A pesticide runoff management plan will be developed
4	Monitoring	2003	Modify existing regional monitoring program to include analysis for organophosphate pesticides and toxicity
5	Special Studies		
5a	Atmospheric deposition	2003	Quantify atmospheric deposition of chlorpyrifos loading to Upper Newport Bay
5b	Mixing volumes in Upper Newport Bay	2003	Model mixing and stratification of chlorpyrifos in Upper Newport Bay during storm events

9.2.1 USEPA RE-REGISTRATION AGREEMENTS

Re-registration of diazinon and chlorpyrifos by the EPA is the most significant factor affecting the implementation plan. The phase-out is a consequence of the Food Quality Protection Act (FQPA) of 1996. The FQPA was passed unanimously by Congress in July 1997, and signed into law in August 1997. The FQPA:

- Establishes a single health-based standard for all pesticide residues in food
- Provides for a more complete assessment of potential risks with special protections for potentially sensitive groups, such as infants and children
- Requires reassessment of all existing pesticide residue limits
- Expedites approval of safer, reduced risk pesticides
- Encourages development of safer, effective crop protection tools
- Ensures that all pesticides are periodically re-evaluated for adherence to current safety standards
- Expands consumers' "right to know" about pesticide risks and benefits

The provisions of the FQPA have an important bearing on implementation of the diazinon and chlorpyrifos TMDL. Reassessment of pesticide residues began with the organophosphates, a group of 48 pesticides. New risk assessments were developed for the two most widely used organophosphates, diazinon and chlorpyrifos. During this process, USEPA negotiated re-registration agreements with the manufacturers of diazinon and chlorpyrifos (USEPA 2000a, 2001). As discussed in Section 4.2, these re-registration agreements are likely to end over 90 percent of the usage (as of 1999) in the Newport Bay watershed.

While acting to restrict most uses of diazinon and chlorpyrifos, the USEPA has also taken action, in accordance with the FQPA, to expedite review of reduced risk pesticides, including biopesticides. Biopesticides are distinguished from conventional chemical pesticides by their unique modes of action, low use volume, lower toxicity, and target species selectivity or natural occurrence. USEPA's actions are intended to ensure that safer alternatives to diazinon and chlorpyrifos are available (USEPA 1999c).

9.2.2 DISCHARGE PERMITS AND COMPLIANCE SCHEDULE

The TMDL allocates wasteloads to all dischargers in the watershed. Since the TMDL is concentration-based, the wasteloads are concentration limits. These concentration limits will be incorporated into existing and future discharge permits in the watershed. A four-year compliance schedule (beginning in 2003) is outlined in Table 9-2, with interim targets that are based on $\frac{1}{2}$ the LC50 values for *Ceriodaphnia dubia*. Compliance would be required as soon as possible but no later than the dates shown. Compliance schedules would be included in permits only if they are demonstrated to be necessary.

Table 9-2. Numeric Target Compliance Schedule

Category	Freshwater Target (ng/L)		
	Interim (By June 2004)	Final (By Dec 2007)	
	<u>Maximum</u>	<u>Acute</u>	<u>Chronic</u>
DIAZINON	220	72	45
CHLORPYRIFOS	30	18	12.6

The revised permits will include additional monitoring for organophosphate pesticides. The monitoring interval will depend on the type of discharge. For example, permits for groundwater dischargers may only need annual monitoring, while dischargers that use diazinon and chlorpyrifos products will require more frequent monitoring.

9.2.3 PESTICIDE RUNOFF MANAGEMENT PLAN

A pesticide runoff management plan (PRMP) will be developed for the watershed as a cooperative project between the Regional Board and stakeholders. The goals of the pesticide management plan will be to:

- Monitor pesticide usage
- Identify pathways leading to pesticide contamination of surface water
- Reduce pesticide runoff to the maximum extent practicable
- Summarize pesticide-related water quality activities on an annual basis

MONITORING USAGE

Table 9-3 shows selected pesticide use reported in Orange County. The pesticides are ranked by usage volume. Only those pesticides ranked in the top 50 that are potential water quality threats are listed. For example, the top three pesticides, soil fumigants that are gases at room temperature, are not listed below, as they are not expected to pose a threat to water quality.

Monitoring pesticide usage will allow management efforts to focus on those pesticides that are potential water quality threats. The available usage data indicate pesticides that should be targeted for water quality monitoring, and along with site-of-use data from the CDPR, may help to identify causes of toxic events in the watershed.

Table 9-3. Selected CDPR-Reported Pesticides Used in Orange County 1999

Rank.	Chemical	Usage (lbs ai)	Comments
4	Chlorpyrifos	79,990	Organophosphate, ag. & urban use (ants)
10	Captan	29,521	Fungicide, fruit & vegetable crops
11	Diazinon	24,452	Organophosphate, ag. & urban use (ants)
17	Permethrin	10,483	Ag. pests, nursery, termites
20	Thiram	6,509	Fungicide
21	Metaldehyde	6,214	Molluscide (snails, slugs)
23	Malathion	5,953	Ag. pests, urban
24	Cypermethrin	5,869	Ag. pests, structural
25	Fosetyl-al	5,330	Fungicide
26	Bifenthrin	5,257	RIFA use
27	Methomyl	3,181	Carbamate, ag. crops, dairies
41	Carbaryl	2,835	Wide spectrum insecticide
48	<i>Bacillus thuringiensis</i> .	1,974	Variety Kurstaki. Over 1,000 lbs of other subspecies also used.
49	Dimethoate	1,964	OP pesticide

IDENTIFYING PATHWAYS

The PRMP should address the significant pathways for pesticide runoff and discharge to surface waters. One of the most significant pathways could be direct disposal of excess pesticides into outdoor gutters. The Residential Sales and Use Survey (Wilén 2001) found that a majority of homeowners were not aware of proper disposal procedures for excess pesticides, or old/expired pesticides.

REDUCING PESTICIDE RUNOFF

Reducing pesticide runoff will require a coordinated effort among the stakeholders in the watershed, and a large education/outreach component to address homeowner use of pesticides. Following is a list of resources that will be used to help achieve reductions in pesticide runoff to levels at which pesticide-derived aquatic toxicity no longer occurs in the watershed.

1. UC Integrated Pest Management (IPM) Project

The University of California statewide Integrated Pest Management project (UC IPM) defines integrated pest management as:

“An ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment.”

The goals of the UC IPM project are to reduce the pesticide load in the environment while increasing the effectiveness of pest control techniques that are economically, environmentally, and socially acceptable. The mission of the UC IPM project also includes outreach to other agencies to promote IPM programs.

The UC IPM project provides eight advisors to help develop, demonstrate, and adapt IPM techniques for various regions in California. The advisor for the region that includes the Newport Bay watershed is Cheryl Wilen, of the South Coast UC Cooperative Extension station. The pesticide runoff management plan for the watershed will be based, to as large an extent as possible, on the existing IPM knowledge from the UC IPM project.

2. CDPR Pest Management Alliance

The Newport Bay watershed contains three large nurseries with waste discharge permits. While the TMDL source analysis shows that most of the diazinon and chlorpyrifos load is from urban areas, many of these uses are being phased out. In contrast, nursery and agricultural uses may continue and even increase due, in part, to quarantine requirements under the RIFA program.

The CDPR has funded two projects for the containerized nursery industry under the pest management alliance program. The first project, involving a survey and evaluation of pest management practices in the industry, was completed in 2000 (Costa et al 2000). The second project report will be available this year, and will contain specific recommendations on practices that will reduce pesticide runoff.

3. USEPA Alternatives To Diazinon And Chlorpyrifos

As described in Section 9.2.1, the USEPA has expedited review of reduced risk pesticides and bio-pesticides. USEPA has registered six new active ingredients that provide lower-risk alternatives to several organophosphates. Information on bio-pesticides can be found at the USEPA website: <http://www.epa.gov/pesticides/biopesticides/>

4. PEST Control Operators (PCOs)

Pest Control Operators apply approximately 40% to 50% of the diazinon and chlorpyrifos in the watershed. PCOs are licensed by the CDPR, except for those licensed by the Structural Pest Control Board or the Department of Health Services.

The TMDL source analysis shows that urban areas account for more than 80% of pesticide runoff. Runoff from urban areas could originate from homeowner use and/or from applications by PCOs.

PCOs are required to meet certain continuing education requirements to meet their license requirements. Included in the list of approved courses is one on environmental protection. The Regional Board will work cooperatively with the State Board and the CDPR to review PCO operations for potential impacts to water quality, and recommend methods to reduce pesticide runoff.

5. Urban Education

The Orange County stormwater permittees have developed and implemented a model plan entitled: *Management Guidelines for Use of Fertilizers and Pesticides*.” The renewed stormwater permit (SARWQCB 2002) requires the permittees to review this plan, determine its effectiveness, and make any needed changes. The county is currently working with UC Cooperative extension and the UC IPM project to revise the plan.

Homeowners and other residential users applied roughly half the diazinon and chlorpyrifos in the watershed during 1999. Because of the USPEPA re-registration agreements, homeowner use will be largely phased out over the next few years. However, homeowners are likely to turn to other pesticides for control of ants and other household pests. Improper or excessive usage of the new pesticides may result in continued aquatic toxicity in the watershed. Therefore, it is important to implement effective public education and outreach programs. A review of education programs and their effectiveness will be performed as part of the pesticide runoff management plan.

ANNUAL EVALUATION REPORT

The Regional Board will produce an annual report summarizing information from all sources and evaluating the effectiveness of the PRMP. The annual evaluation report will integrate information from the Regional Board’s Stormwater, NPDES, and Non-Point Source programs with data from other agencies and from monitoring projects in the watershed. A sample report outline is presented on the following page.

Sample Outline: Annual Pesticide Runoff Management Evaluation Report

1. Summary of Water Quality Data
 - Regional Monitoring Program
 - Nurseries
 - Other studies/investigations in watershed
 - State Mussel Watch (SMW) and Toxic Substances Monitoring (TSMP) Program
 - Compare to TMDL, permit compliance
 - Identify pesticide-derived aquatic toxicity
 - Monitor new pesticide water quality threats
2. Pesticide Usage
 - Reported uses – CDPR Database
 - Residential/homeowner use – Design mini-survey based on Residential Survey Report (Wilen 2001)
 - Identify trends in usage
 - Confirm reduction in diazinon/chlorpyrifos use
 - Monitor usage of pesticides with potential runoff/toxicity problems
 - Track adoption/use of bio-pesticides and reduced risk pesticides
3. Best Management Practices
 - Summarize research and development activities
 - Summarize implementation activities
4. Education/Outreach Review
 - Stormwater Permit programs
 - UC Cooperative Extension and UC IPM activities in watershed
 - CDPR Pest Management Alliance activities in watershed
5. Special Projects
 - RIFA program
 - Others
6. Summary and Recommendations
 - Evaluate effectiveness of PRMP
 - Recommend Changes

9.2.4 MONITORING

A Regional Monitoring Program (RMP) has been developed for the watershed as part of the nutrient TMDL. The RMP is intended to provide for efficient monitoring of the watershed through a cooperative, comprehensive monitoring program. The OCPFRD is the lead agency for the RMP. All dischargers are allowed to participate in the RMP in lieu of implementing separate, individual monitoring and reporting programs.

The RMP currently includes nine stations in the watershed and five stations in Upper Newport Bay. The number and location of the stations appears sufficient for implementation of the diazinon and chlorpyrifos TMDL. The existing monthly sampling frequency plus additional monitoring of storm events will provide the necessary data to ensure that the TMDL objectives are being achieved.

Aside from diazinon and chlorpyrifos, additional analytes for monitoring may include: bifenthrin (sediment and water column), carbaryl, dimethoate, malathion, and methomyl.

9.2.5 SPECIAL STUDIES

Two issues were identified during development of the TMDL that require further analysis:

- (1) The significance of atmospheric deposition to Upper Newport bay as a separate chlorpyrifos source; and,
- (2) The adequacy of the freshwater numeric targets for chlorpyrifos in the tributaries to Upper Newport Bay in achieving the lower saltwater numeric target.

The significance of atmospheric deposition for chlorpyrifos loading to Upper Newport bay will be quantified through analysis of rainwater samples in the vicinity of the Bay.

The existing hydrodynamic model for Newport Bay is being used to perform simulations that predict contaminant concentrations in the Bay based on various flow and management scenarios. The model results can be used to verify whether the numeric targets for chlorpyrifos in the watershed will be sufficient to achieve the TMDL in Upper Newport Bay.

Data from these studies may be used to refine the TMDL. Chlorpyrifos allocations for San Diego Creek may be changed, and additional targeted source control efforts may be incorporated into the implementation.

9.3 ECONOMIC CONSIDERATIONS

As previously stated, the Regional Board is required to include TMDLs in the Basin Plan. There are three statutory triggers for consideration of economics in basin planning. These triggers are:

- Adoption of an agricultural water quality control program (Water Code Section 13141). The Regional Board must estimate costs and identify potential financing sources in the Basin Plan before implementing any agricultural water quality control plan.
- Adoption of a treatment requirement or performance standard. The Regional Board must comply with the California Environmental Quality Act (CEQA) when amending the Basin Plan. CEQA requires that the Board consider the environmental effects of reasonably foreseeable methods of compliance with Basin Plan amendments that establish performance standards or treatment requirements, such as TMDLs. The costs of the methods of compliance must be considered in this analysis.
- Adoption of water quality objectives (Water Code Section 13241). The Regional Board is required to consider a number of factors, including economics, when establishing or revising water quality objectives in the Basin Plan.

It should be noted that in each of these cases, there is no statutory requirement for a formal cost-benefit analysis.

As discussed above, adoption of a TMDL does not constitute the adoption of new or revised water quality objectives, so the third statutory trigger does not apply here. However, implementation of this TMDL is likely to result in changes in agricultural (nursery) operations to control pesticide runoff. Similarly, implementation of this TMDL will likely necessitate changes in programs (including educational programs and BMPs) designed to reduce pesticide inputs from urban stormwater or other sources. It is necessary, therefore, to consider the costs and potential funding mechanisms for the implementation of new/modified agricultural water quality control programs, and the costs of other measures that may be necessary to achieve (and monitor) compliance with the TMDL.

The U.S. EPA re-registration agreements for diazinon and chlorpyrifos will result in dramatic reductions in the use of these chemicals and switches to alternative pesticides. While these new agreements are identified as a key part of this implementation plan, they are not within the Regional Board's jurisdiction and the costs of their implementation cannot be considered TMDL-related costs.

Information concerning the costs of implementation of this TMDL will be solicited during the public participation phase of consideration of this TMDL. Specifically, potentially affected parties will be asked to evaluate the TMDL-related costs, as distinct from those associated with implementation of the re-registration agreements. Given that the re-registration agreements will eliminate household uses of these pesticides, the impacts of the TMDL on urban stormwater permittees are expected to be minimal. Expenditures beyond those now necessary to comply with the established areawide urban stormwater permit would likely be focused on increased/enhanced public education efforts to assure proper pesticide use and disposal. Higher costs are likely to be incurred by agricultural operations (nurseries) to assure that RIFA-related pesticide applications do not result in pesticide runoff. The following section identifies possible sources of funding.

9.4 POTENTIAL FUNDING SOURCES

Potential funding sources include the Prop 13 pesticide grant program, and EPA and State Board annual program funds for NPS activities and TMDL implementation. Local agencies or non-governmental entities may also have programs to support the implementation plan. Following is a list of identified funding sources:

A. Grant Programs

1. National Foundation for IPM Education. “The National Foundation for Integrated Pest Management (IPM) is a not-for-profit public foundation that promotes education, provides information and encourages research to increase the adoption of IPM.”
<http://www.ipm-education.org/>
2. EPA 319h Program The Division of Water Quality, State Water Resources Control Board (SWRCB) administers water quality grants funded by the Federal Clean Water Act (CWA) section 319 grant program. CWA section 319 funds may be used for implementing actions to prevent, control and/or abate nonpoint source (NPS) water pollution http://www.swrcb.ca.gov/nps/cwa_rfps.html
3. Proposition 13. In March 2000, California voters approved Proposition 13 (2000 Water Bond), which authorizes the State of California to sell \$1.97 billion in general obligation bonds to support safe drinking, water quality, flood protection and water reliability projects throughout the state. The State Water Resources Control Board (SWRCB) will help allocate \$763.9 million of these funds to local projects throughout California. The SWRCB created the following web page to provide a quick digest of available bond programs and information on how interested parties should submit proposals for available money. A portion of the Prop 13 funds have been set aside to support pesticide-related water quality issues. <http://www.swrcb.ca.gov/prop13/index.html>
4. UC IPM project grants
5. CDPR Pest Management Alliance
6. State Board/Regional Board Funds – NPS Program funding sources:
<http://www.swrcb.ca.gov/nps/ofundsrc.html>

B. Private financing (corporations or individuals)

C. Public financing (local agencies)

1. State loan programs
2. Local tax funds

10.0 REFERENCES

- Bailey, HC, DiGiorgia, C, and DE Hinton 1993. Newport Bay Watershed Toxicity Study, Submitted to the Santa Ana Regional Water Quality Control Board
- California Department of Food and Agriculture (CDFA) 1999. Red Imported Fire Ant. California Action Plan
- California Department of Fish and Game (CDFG) 2000a. Water Quality Criteria for Diazinon and Chlorpyrifos
- CDFG 2000b. Results of Chemical and Toxicological Analyses of Sediment and Chemical Analysis of Fish Tissue in Conjunction with the Red Imported Fire Ant Control Project. Memorandum to Santa Ana Regional Water Quality Control Board (SARWQCB)
- California Department of Pesticide Regulation (CDPR) 2000. RIFA Insecticides and other Organophosphates: Use Pattern, Concentration, and Toxicity in Runoff Water, Source Identification, and Mitigation Measures
- CDPR 1999-2000. Preliminary Results of Pesticide Analysis and Acute Toxicity Testing of Monthly Surface Water Monitoring for the RIFA Project in Orange County. (Monthly monitoring memos)
- CDPR 2000. Pesticide Use Report Database. www.cdpr.gov.
- Costa, H., R Krieger, L Greenberg, M Rust, J Kabashima, and C Wilen, 2000. Pest Management Alliance for the Containerized Nursery Industry. Report prepared for the CDPR. Contract number 99-0201
- EXTOXNET 1995-1996. Pesticide Information Profiles.
(website: <http://ace.orst.edu/info/extoxnet/pips/ghindex.html>)
- Giesy JP, Solomon KR, Coats JR, Dixon K, Giddings J, and EE Kenaga 1998. Ecological Risk Assessment of Chlorpyrifos in North American Aquatic Environments: Report of an Expert Panel. Dow AgroSciences LLC Study ID: GH-C 4660
- Hall, L and R Anderson 2000. A Site-Specific Probabilistic Ecological Risk Assessment for Diazinon in California's Newport Bay Watershed
- Hall, L and R Anderson 2000. A Site-Specific Probabilistic Ecological Risk Assessment for Diazinon in California's Newport Bay Watershed
- Kabashima, J. 2002. Personal communication. University of California, South Coast Research and Extension Center, Irvine.

- Katznelson R and T Mumley 1997. Diazinon in Surface Waters of the San Francisco Bay Area: Occurrence and Potential Impact. Report for San Francisco Regional Water Quality Control Board
- Lee, GF and S Taylor 1999. Results of Aquatic Life Toxicity Studies Conducted During 1997-1999 in the Upper Newport Bay Watershed and Review of Existing Water Quality Characteristics of Upper Newport Bay and its Watershed. USEPA 205(j) project report
- Lee, GF and S Taylor 2001. Results of Aquatic Toxicity Testing Conducted During 1999-2000 in the Upper Newport Bay Watersheds. USEPA 319(h) project report
- Montgomery, JH 1993. Agrochemical Desk Reference: Environmental Data. Ann Arbor, Michigan, Lewis Publishers 625p
- Novartis Crop Protection Inc 1997. An Ecological Risk Assessment of Diazinon in the Sacramento and San Joaquin River Basins, Technical Report 11-97
- Orange County Public Facilities and Resources Department (OCPFRD) 1999. Orange County NPDES Stormwater Program, Annual Progress Report
- Office of Environmental Health Hazard Assessment (OEHHA) 1999. Prevalence of Selected Target Chemical Contaminants in Sport Fish from Two California Lakes: Public Health Screening Study
- Santa Ana Regional Water Quality Control Board (SARWQCB) 1995. Water Quality Control Plan [Basin Plan], Santa Ana River Basin – Region 8
- SARWQCB 2001. Final Problem Statement for the Total Maximum Daily Load for Toxic Substances in Newport Bay and San Diego Creek. Staff Report
- SARWQCB 2002. Waste Discharge Requirements, County of Orange, Orange County Flood Control District, Incorporated Cities of Orange County within the Santa Ana Region Areawide Storm Water Runoff. Order No. R8-2002-0010, NPDES No. CA-S618030
- Scanlin, J and A Feng 1997. Characterization of the Presence and Sources of Diazinon in the Castro Valley Creek Watershed. Prepared for the Alameda Countywide Clean Water Program and the Alameda County Flood Control and Water Conservation District
- State Water Resources Control Board [SWRCB] 2000. State Mussel Watch Database; 1980-1996
- SWRCB 2001. Toxic Substances Monitoring Program Database and Data Reports; 1983-2000
- TDC Environmental 2001. Diazinon and Chlorpyrifos Products: Screening for Water Quality Implications.

United States Environmental Protection Agency (USEPA) 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses, Office of Research and Development, Washington, D.C.

USEPA 1999a. Environmental Risk Assessment for Diazinon

USEPA 1999b. Pesticides Industry Sales and Usage. 1996 and 1997 Market Estimates.

USEPA 1999c. Implementing the Food Quality Protection Act: Progress Report. EPA 735-R-99001

USEPA 2000a. Chlorpyrifos Revised Risk Assessment and Agreement with Registrants

USEPA 2000b. Letter from Alexis Strauss to the Central Valley Regional Water Quality Control Board

USEPA 2001. Diazinon Revised Risk Assessment and Agreement with Registrants

USEPA 2002. Total Maximum Daily Loads for Toxic Pollutants, San Diego Creek and Newport Bay, California

United States Geologic Survey (USGS) 2000. Stormflow chemistry in the Santa Ana River below Prado Dam and at the diversion downstream from Imperial Highway, Southern California, 1995-98

Wilen, C 2001. A survey of residential pesticide use and sales in San Diego Creek watershed of Orange County, California. Prepared for the CDPR, University of California – Riverside, Statewide Integrated Pest Management Program

APPENDIX B

SCIENTIFIC PEER REVIEW COMMENTS AND RESPONSES

Diazinon and Chlorpyrifos TMDL Upper Newport Bay and San Diego Creek (Draft of November 15, 2002)

Peer Reviewers:

(1) Ronald S. Tjeerdema, Ph.D., DABT, Professor of Environmental Toxicology,
University of California, Davis
January 10, 2003 letter to Wanda Smith

(2) Michael Stenstrom, Ph.D., P.E., Professor of Civil and Environmental Engineering,
University of California, Los Angeles
February 3, 2003 letter to Wanda Smith via email

Dr. Tjeerdema, General Comment:

In general, the document is well written and thorough. I like the approach of developing concentration-based, instead of mass-based, TMDLs for both insecticides. Also, as it is clear the use of both agents will be phased out for most applications over the next several years, this is considered a significant factor in attaining the targets for both San Diego Creek and Newport Bay. In general, the data used appear to be both reliable and their treatment here is generally defensible. Rationale is clearly stated, thus the report also supports its conclusions and recommendations. However, I do have several specific comments/recommendations, which are presented below.

For additional information on the environmental fate and toxic actions of diazinon, please refer to the following review:

Larkin, D. J. and R. S. Tjeerdema, 2000. Fate and Effects of Diazinon. *Reviews of Environmental Contamination and Toxicology* 166:49-82.

Dr. Tjeerdema, Specific Comments:

1. *Page 11. The reference LC50s for diazinon and chlorpyrifos in Ceriodaphnia, as reported by the California Department of Fish and Game (CDFG), are 440 and 60 ng/L, respectively. Since the numeric targets adopted for the TMDLs are based on the criteria derived by CDFG (please see pages 14 through 16), please provide a brief summary of how they were derived (using the referenced EPA guidelines). Also, please include the measured NOECs from the same CDFG tests. It is important to understand how the water quality criteria relate to the measured NOECs as well as the LC50s.*

Response: The *Ceriodaphnia* LC-50s were derived using seven acceptable tests for diazinon, and five acceptable tests for chlorpyrifos. Geometric means of the LC50s reported in these tests were calculated to derive the reported freshwater LC50s of 440 ng/L for diazinon and 60 ng/L for chlorpyrifos. Abstracts of these tests are available in the CDFG report (CDFG 200a). NOECs were not reported for most of the tests. For diazinon, the average acute NOEC for two of the *Ceriodaphnia* tests was 350 ng/L, while a chronic NOEC was reported as 220 ng/L. No acute NOECs were reported for chlorpyrifos, however a chronic NOEC of 29 ng/L was reported. This information has been incorporated into Table 3-1 of the TMDL report.

It should be emphasized that the recommended CDFG criteria were derived using toxicity data from eight families of aquatic animals. Acute toxicity values (LC50s and EC50s) were assembled from tests that met standard acceptance protocols defined in USEPA guidelines (1985) and ASTM standards. For diazinon, a total of 40 acceptable tests from 15 genera were used, and for chlorpyrifos a total of 33 acceptable tests from 18 genera were used. Genus mean acute values (GMAVs) were calculated using the geometric means of the reported acute values (LC50s or EC50s), and the four lowest GMAVs were used to calculate the acute criteria. Chronic criteria were derived using acute-to-chronic ratios. Thus *Ceriodaphnia* represented only one of the four genera used. This information has been included in Section 3.0 of the report.

2. *Page 18. Hydrolysis of diazinon is also considered a major dissipation pathway and, similar to chlorpyrifos, it is also pH dependent, as both slightly acidic and alkaline conditions enhance its degradation. Please refer to a pesticide reference text for more specific information to include in this section.*

Response: Additional text describing the hydrolysis dissipation pathway has been added to Section 4.1 as follows:

“For diazinon, major routes for dissipation are hydrolysis, biodegradation, volatilization, and photolysis (USEPA 1999a). Diazinon degrades rapidly by hydrolysis under acidic conditions (half-life of 12 days at pH 5). Hydrolysis is slower under neutral and alkaline conditions (abiotic hydrolysis half-lives of 138 days at pH 7, and 77 days at pH 9).”

3. Pages 18 and 19. Volatilization is cited as a major dissipation route for both insecticides (this is also discussed later in the draft), yet Table 4-1 lacks both vapor pressure (P) and Henry's law constant values (measured and/or calculated). Please add them, as they are readily available from reference texts and lend insight to the fate of both diazinon and chlorpyrifos.

Response: Table 4-1 has been updated to include the data requested:

Pesticide	<i>Ceriodaphnia</i> LC50 (ng/L)	Solubility (mg/L)	Adsorption Coefficient (dim'less)	Henry's Law (atm-mol/m ³)	Vapor Pressure (mmHg)	Half-Lives (days)	
						Soil	Water
Bifenthrin	78	0.1	1,000,000	n/a	n/a	7-240	n/a
Carbaryl	3,380	40	300	1.27×10^{-5}	4.1×10^{-5}	7-28	10
Chlorpyrifos	60	2	6070	4.16×10^{-6}	1.87×10^{-5}	60-120	30-75
Diazinon	440	40	1000	1.13×10^{-7}	8.47×10^{-5}	14-28	180
DDT	4,700	<1	100,000	n/a	n/a	2-15 years	20-60
Malathion	1,140	130	2.75	4.89×10^{-9}	1.25×10^{-6}	1-25	< 7

Sources: EXTOXNET Pesticide Information Profiles; CDFG (2000a); Montgomery (1993)
n/a=not available; dim'less=dimensionless

4. Pages 33 and 36. Atmospheric deposition is discussed as a source to the watershed of the two insecticides. In order to predict the magnitude of contribution, it is valuable to know the Henry's law constants, which can be used to estimate chemical partitioning between air-water interfaces. Please see my request in #3, above.

Response: Table 4-1 has been updated with the Henry's law data (see above)

Dr. Stenstrom, General Comments:

I am replying to your request for a review of the proposed TMDL for diazinon and chlorpyrifos in the Newport Bay Watershed. In your request you specifically asked me to consider if the data used in developing the report is reliable and defensible, and does the report as a whole support its scientific conclusions and recommendations. I conclude that it does, and I provide other comments later in this letter.

In the middle and later half of the 1990's, water quality toxicity was noted in many areas in California, and stormwater was suspected. Many toxicity studies were performed (some at UCLA in my laboratory). Gradually it became clear that the pesticides diazinon and chlorpyrifos were responsible. The draft TMDL documents several such studies for the Upper Newport Bay and San Diego Creek watersheds. Lee et al. conducted two studies with US EPA funding. The studies were specifically conducted to determine the existence of aquatic toxicity, and if possible, the source of the toxicity. The second study (final report dated May 2001) was successful in detected toxicity in the majority of the samples, including all stormwater samples. The "samples were highly toxic to Ceriodaphnia dubia and Mysidopsis bahia." They found no toxicity to fathead minnows or alga Selenastrum. They found approximately one-third to one-half of the toxicity to be from diazinon and/or chlorpyrifos. Diazinon and chlorpyrifos were implicated in specific samples to a much higher extent. I view this report as strong confirmation of what we suspected much earlier.

Contract laboratories performed the actual analyses. Aqua Science and UC Davis Aquatic Toxicology Lab. I reviewed the Aqua Science report and the UC Davis lab is known to me from other investigations. APPL Laboratories performed diazinon and chlorpyrifos analyses. I did not review their report, but I am familiar with analytical methods for these two pesticides. We perform pesticide analysis by GC and GC/MSD in my laboratory at UCLA. I am familiar with the Elisa procedures, although we do not perform this method in my laboratory. I regard it as a less expensive, quick method; it is useful but usually less precise than GC, HP/LC or GC/MSD methods. The differences between analytical methods noted in the Lee report do not surprise me, and they do not detract from the validity of the report's results or conclusions. Also, I do not believe a simple error such as inaccurate standards (as Lee suggests) is the reason the differences. It is more likely that the differences are due to matrix effects in the samples.

I would also like to note that attributing the source of the toxicity to diazinon and chlorpyrifos is a strong finding. It is much more common for toxicity studies to fail in their identification of toxicants, or to be able to identify them only by broad class (e.g., metals, oxidants, organic compounds, etc.).

It is my opinion that there is cogent, scientifically valid evidence that significant and frequent aquatic toxicity exists in these two watersheds, and that it is due to presence of diazinon and chlorpyrifos. There are other pollutants in the watershed and they may create aquatic toxicity as well; however, the preponderance of the toxicity is from diazinon and chlorpyrifos.

The draft TMDL cites surveys and other data that document the use of diazinon and chlorpyrifos in the two watersheds by landuse and other parameters. I have used similar data in my research. It is a useful way of showing the mass burden of a watershed for specific compounds.

Fortunately, reductions of diazinon and chlorpyrifos will occur because of its withdrawal from the market for use. The Lee et al report documents this withdrawal and projects a decline in usage by 75%. This is good news, but I caution against any speculation that this may eliminate the need for a TMDL. There is no way of accurately predicting, at least at this time with available data, just how long it will take for diazinon and chlorpyrifos concentrations to decline. We still find significant concentrations of DDT and other banned pesticides, even though they have not been used in quite some time. It might be possible to study the potential decline in concentrations and speculate with bounded uncertainty about the expected decline. This might be a useful future study. I believe a TMDL is still necessary.

The draft TMDL identifies the beneficial uses of San Diego Creek and Upper Newport Bay. These include uses that may not be very sensitive to diazinon and chlorpyrifos, such as non-contact recreation, but also uses that can be strongly impacted by aquatic toxicity (e.g. habitat and spawning, reproduction and development). These uses justify the requirements for a TMDL.

Lee et al. note that bioaccumulation of the two pesticides does not occur and other data in the draft TMDL support their assertions. They also speculate that a TMDL could be created around the expected food consumption of harvested fish. This would not be an appropriate method for establishing a TMDL, since the limits would not be protective of the other beneficial uses, noted above.

The draft TMDL in Chapter 3 develops numerical water quality objectives. This is necessary because California and the US EPA have not created numerical concentration standards. I have reviewed the procedures for establishing the values, specifically, those in Table 3-1. They are based upon the California Department of Fish and Game's analysis (Water Quality Criteria for Diazinon and Chlorpyrifos, Administrative Report 00-3, 2000, Office of Spill Prevention and Response). The authors of this report compiled all known toxicity studies for diazinon and chlorpyrifos and compared them to the criteria presented in US EPA Report Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses, by Stephan, et al. (1985). I believe the values shown in Table 3-1 are consistent with this procedure and represent a scientifically valid method, consistent with US EPA procedures, for establishing numerical targets.

Response: Comments noted. We agree that monitoring to assess the efficacy of implementation of the TMDL and BMPs will be necessary. Where

existing BMPs are not shown to be effective, revised/new BMPs will need to be implemented. Comments about need/recommendations for additional studies are noted.

APPENDIX C

California Regional Water Quality Control Board Santa Ana Region

RESOLUTION NO. R8-2003-039

**Resolution Amending the Water Quality Control Plan for the Santa Ana River Basin to
Incorporate a Diazinon and Chlorpyrifos Total Maximum Daily Load for San Diego
Creek and Upper Newport Bay**

**WHEREAS, the California Regional Water Quality Control Board, Santa Ana
Region (hereinafter, Regional Board), finds that:**

1. An updated Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) was adopted by the Regional Board on March 11, 1994, approved by the State Water Resources Control Board (SWRCB) on July 21, 1994, and approved by the Office of Administrative Law (OAL) on January 24, 1995.
2. The Basin Plan specifies the narrative water quality objective for San Diego Creek and Upper Newport Bay that toxic substances shall not cause adverse impacts to beneficial uses.
3. The narrative objective for toxic substances is not being achieved in San Diego Creek and Upper Newport Bay due to persistent aquatic toxicity, as demonstrated by monitoring data collected from these waterbodies. Beneficial uses adversely impacted by aquatic life toxicity include WILD and WARM in San Diego Creek and BIOL, COMM, EST, MAR, RARE, and SPWN in Upper Newport Bay.
4. Investigations conducted in San Diego Creek demonstrate that persistent aquatic toxicity is caused largely by diazinon and chlorpyrifos. Investigations conducted in Upper Newport Bay demonstrate that persistent aquatic toxicity is caused largely by chlorpyrifos.
5. In response to the findings of aquatic toxicity, the Regional Board listed San Diego Creek and Newport Bay as water quality limited in accordance with Section 303(d) of the Clean Water Act. Section 303(d) requires the establishment of a Total Maximum Daily Load (TMDL) for the pollutant(s) causing the toxicity (diazinon and chlorpyrifos). Section 303(d) also requires the allocation of the TMDL among sources of diazinon and chlorpyrifos. State law requires an implementation plan and schedule to ensure that the TMDL is met and compliance with water quality standards is achieved.
6. On June 14, 2002, the U.S. Environmental Protection Agency (U.S. EPA) established a TMDL for diazinon and chlorpyrifos in San Diego Creek and, for chlorpyrifos in Upper Newport Bay. The U.S. EPA TMDL did not include an implementation plan.

7. The Basin Plan amendment shown in the attachment to this Resolution was developed in accordance with Water Code Section 13240 *et seq.* The amendment is proposed for incorporation into Chapter 5 “Implementation”, of the Basin Plan. The amendment specifies a TMDL that includes an implementation plan but is otherwise identical to the TMDL established by the U.S. EPA with respect to the numeric targets and load allocations. The proposed Basin Plan amendment also provides background information concerning the water quality impairment being addressed, and the sources of diazinon and chlorpyrifos in the Newport Bay watershed. The proposed TMDL is supported by a detailed report prepared by Regional Board staff and titled “Diazinon and Chlorpyrifos TMDL, Upper Newport Bay and San Diego Creek, February 21, 2002 (hereinafter, “TMDL Report”).
8. The process of basin planning has been certified by the Secretary of Resources as functionally equivalent to the preparation of an Environmental Impact Report or Negative Declaration, as required by the California Environmental Quality Act (Public Resources Code Section §21000 *et seq.*). The Basin Plan amendment package includes an Environmental Checklist and staff reports that include an assessment of the potential environmental impacts of the Basin Plan amendment and a discussion of alternatives. The amended Basin Plan, Environmental Checklist, staff reports, and supporting documentation are functionally equivalent to an Environmental Impact Report or Negative Declaration.
9. The proposed amendment will result in no potential for adverse effect, either individually or cumulatively, on wildlife.
10. The Regional Board has considered federal and state anti-degradation policies and other relevant water quality control policies and finds the amendment consistent with those policies.
11. The TMDL Report was scientifically peer reviewed in January and February, 2003. In response to the comments received, additional data concerning degradation pathways for diazinon and chlorpyrifos were added to the TMDL Report. No changes to the proposed Basin Plan amendment shown in the Attachment to this Resolution were required.
12. In February 2003, a Notice of Filing, the TMDL Report, environmental checklist, and the draft amendment were prepared and distributed to interested individuals and public agencies for review and comment in accordance with state and federal regulations (23 CCR §3775, 40 CFR 25 and 40 CFR 131).
13. On February 21, 2003, the Regional Board held a Public Workshop to consider the Basin Plan amendment. This meeting served as Public Scoping meeting as required

by the California Environmental Quality Act. Notice of the workshop was given to all interested persons.

14. Notice of the public hearing to consider adoption of the proposed Basin Plan amendment was published in accordance with Water Code Section §13244.
15. This amendment will affect all dischargers in the Newport Bay Watershed by requiring them to institute monitoring programs for diazinon and chlorpyrifos, and imposing limits on discharges of these compounds.

The Regional Board has considered the costs of implementing the amendment, and finds these costs to be reasonable. The costs associated with the reductions in diazinon and chlorpyrifos required by the TMDL will result largely from the re-registration agreements for these compounds, and not the TMDL.

16. The Basin Plan amendment must be submitted for review and approval by the SWRCB, OAL, and the U.S. Environmental Protection Agency (U.S. EPA). Once approved by the SWRCB, the amendment is submitted to OAL. A Notice of Decision will be filed after the SWRCB and OAL have acted on this matter. The SWRCB will forward the approved amendment to EPA for review and approval.
17. For the purposes of specifying compliance schedules in NPDES permits for effluent limitations necessary to implement this TMDL, the schedule(s) specified in this TMDL shall govern, notwithstanding other compliance schedule authorization language in the Basin Plan.
18. The adoption of this TMDL is necessary to reduce loadings of diazinon and chlorpyrifos, and to address water quality impairments that arise therefrom.

NOW, THEREFORE BE IT RESOLVED THAT:

1. The Regional Board adopts the amendment to the Water Quality Control Plan for the Santa Ana River Basin (Region 8) as set forth in the attachment.
2. The Executive Officer is directed to forward copies of the Basin Plan amendment to the SWRCB in accordance with the requirements of Section §13245 of the California Water Code.
3. The Regional Board requests that the SWRCB approve the Basin Plan amendment in accordance with Sections §13245 and §13246 of the California Water Code and forward it to the OAL and U.S. EPA for approval.
4. If during its approval process, the SWRCB or OAL determines that minor, non-substantive corrections to the language of the amendment are needed for clarity or

consistency, the Executive Officer may make such changes, and shall inform the Board of any such changes.

5. The Executive Officer is authorized to sign a Certificate of Fee Exemption in lieu of payment of the California Department of Fish and Game filing fee.

I, Gerard J. Thibeault, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a resolution adopted by the California Regional Water Quality Control Board, Santa Ana Region, on April 4, 2003.

Gerard J. Thibeault
Executive Officer

TENTATIVE

APPENDIX D ATTACHMENT TO RESOLUTION NO. R8-2003-039

Amendment to the Santa Ana Region Basin Plan

Chapter 5 - Implementation Plan, Discussion of Newport Bay Watershed (page 5-41 *et seq*)

5.4 Toxic Substances Contamination

Aquatic toxicity in San Diego Creek and Upper Newport Bay causes adverse impacts on the established beneficial uses of those waterbodies.

A report prepared by Regional Board staff describes the aquatic life toxicity problems in San Diego Creek and Upper Newport Bay in greater detail and discusses the technical basis for the TMDL that follows¹. The TMDL addresses toxicity due to diazinon and chlorpyrifos in San Diego Creek and chlorpyrifos in Upper Newport Bay. Implementation of this TMDL is expected to address, to a significant extent, the occurrence of aquatic life toxicity in these waterbodies. Reduction in aquatic life toxicity will help assure attainment of water quality standards, that is, compliance with water quality objectives and protection of beneficial uses.

5.4.a Diazinon and Chlorpyrifos TMDL

Table 5-9i shows the TMDL and the allocations for diazinon and chlorpyrifos in San Diego Creek.

Table 5-9i. Diazinon and Chlorpyrifos Allocations for San Diego Creek

Category	Diazinon (ng/L)		Chlorpyrifos (ng/L)	
	Acute	Chronic	Acute	Chronic
Wasteload Allocation	72	45	18	12.6
Load allocation	72	45	18	12.6
MOS	8	5	2	1.4
TMDL	80	50	20	14

MOS = Margin of Safety; Chronic means 4-consecutive day average

Table 5-9j shows the TMDL and the allocations for chlorpyrifos in Upper Newport Bay.

Table 5-9j. Chlorpyrifos Allocations for Upper Newport Bay

Category	Acute (ng/L)	Chronic (ng/L)
Wasteload allocation	18	8.1
Load allocation	18	8.1
MOS	2.0	0.9
TMDL	20	9

MOS = Margin of Safety; Chronic means 4-consecutive day average

¹ Diazinon and Chlorpyrifos TMDL, Upper Newport Bay and San Diego Creek, February 21, 2003

The TMDL and its allocations contain an explicit 10% margin of safety. In addition, a substantial margin of safety is implicitly incorporated in the TMDL through use of conservative assumptions

5.4.a.i TMDL Implementation

Table 5-9k outlines the tasks and schedules to implement the TMDL.

Table 5-9k. TMDL Task Schedule

Task No.	Task	Schedule	Description
1	Revise Discharge Permits	2005	WDR and NPDES permits will be revised to include the TMDL allocations, as appropriate.
2	Pesticide Runoff Management Plan	2004	A pesticide runoff management plan will be developed
3	Monitoring	2003	Modify existing regional monitoring program to include analysis for organophosphate pesticides and toxicity
4	Special Studies		
4a	Atmospheric deposition	2003	Quantify atmospheric deposition of chlorpyrifos loading to Upper Newport Bay
4b	Mixing volumes in Upper Newport Bay	2003	Model mixing and stratification of chlorpyrifos in Upper Newport Bay during storm events

Task 1: Revise Discharge Permits

The TMDL allocates wasteloads to all dischargers in the watershed. Since the TMDL is concentration-based, these wasteloads are concentration limits. The concentration limits will be incorporated into existing and future discharge permits in the watershed. Compliance schedules would be included in permits only if they are demonstrated to be necessary. Compliance would be required as soon as possible but no later than December 1, 2007.

Task 2: Pesticide Runoff Management Plan

A pesticide runoff management plan will be developed for the watershed as a cooperative project between the Regional Board and stakeholders.

Task 3: Monitoring

Routine monitoring is necessary to assess compliance with the allocations specified in the TMDL. The County of Orange, the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest and Newport Beach, and the agricultural operators in the Newport Bay watershed will be required to propose a plan by January 30, 2004, for routine monitoring to

determine compliance with the TMDL allocations for diazinon and chlorpyrifos. At a minimum, the proposed plan must include the collection of monthly samples at the stations specified in **Table 5-9I** and shown in **Figure 5-2** and analysis of the samples for diazinon and chlorpyrifos. Monthly toxicity tests should also be conducted at several locations in the watershed. Data summaries will be required monthly. An annual report summarizing the data collected for the year and evaluating compliance with the TMDL will be required.

In lieu of this coordinated, regional monitoring plan, one or more of the parties identified in the preceding paragraph may submit an individual or group plan to conduct routine monitoring in areas solely within their jurisdiction to determine compliance with the TMDL. Any such individual or group plans must also be submitted by January 30, 2004. Reports of the data collected pursuant to approved individual/group plan(s) will be required to be submitted monthly and an annual report summarizing the data and evaluating compliance with the TMDL will be required to be submitted by September 1 of each year.

It is likely that implementation of these requirements will be required through the issuance of Water Code Section 13267 letters to the affected parties. The monitoring plan(s) will be considered by the Regional Board and implemented upon the Regional Board's approval.

Task 4: Special Studies

Special investigations are needed to (1) quantify the significance of atmospheric deposition of chlorpyrifos to Upper Newport Bay, and (2) determine the adequacy of the freshwater numeric targets for chlorpyrifos in the tributaries to Upper Newport Bay in achieving the lower saltwater numeric target. The existing hydrodynamic model for Newport Bay is being used to perform simulations that predict contaminant concentrations in the Bay based on various flow and management scenarios. The model results can be used to verify whether the numeric targets for chlorpyrifos in the watershed will be sufficient to achieve the TMDL in Upper Newport Bay. One of the questions to be addressed is the magnitude of toxic exposure that could result from development of a freshwater lens associated with the discharge of stormwater to Upper Newport Bay.

5.4.a.2 Adjust TMDL

Based on the results of the special studies and recommendations made in the Pesticide Runoff Monitoring reports, changes to the TMDL may be warranted. Such changes would be considered through the Basin Plan Amendment process.

The Regional Board is committed to the review of this TMDL every three years or more frequently if warranted by these or other studies.

APPENDIX E

ENVIRONMENTAL CHECKLIST

I. BACKGROUND

1. **Project title:** *Diazinon and Chlorpyrifos TMDL for San Diego Creek and Upper Newport Bay, Resolution No. R8-2003-039*
2. **Lead agency name and address:** *California Regional Water Quality Control Board, Santa Ana Region, 3737 Main Street, Suite 500, Riverside, CA 92501-3348*
3. **Contact person and phone number:** *Wanda Smith (909) 782- 4468*
4. **Project location:** *Newport Bay Watershed, Orange County (all or portions of Costa Mesa, Irvine, Lake Forest, Laguna Hills, Laguna Woods, Newport Beach, Orange, and Santa Ana, Tustin)*
5. **Project sponsor's name and address:** *California Regional Water Quality Control Board, Santa Ana Region, 3737 Main Street, Suite 500, Riverside, CA 92501-3348*
6. **General plan designation:** *Not applicable*
7. **Zoning:** *Not applicable*
8. **Description of project:** *Resolution No. R8-2003-039 will establish target concentrations for the concentrations of diazinon and chlorpyrifos in water discharged to Upper Newport Bay and San Diego Creek and their tributaries. See Attachment "A" to Resolution No. R8-2003-039*
9. **Surrounding land uses and setting:** *Not applicable*
10. **Other public agencies whose approval is required:** *State Water Resources Control Board, Office of Administrative Law, U.S. Environmental Protection Agency*

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

<input type="checkbox"/> Aesthetics	<input type="checkbox"/> Agricultural Resources	<input type="checkbox"/> Air Quality
<input type="checkbox"/> Biological Resources	<input type="checkbox"/> Cultural Resources	<input type="checkbox"/> Geology/Soils
<input type="checkbox"/> Hazards & Hazardous Materials	<input type="checkbox"/> Hydrology / Water Quality	<input type="checkbox"/> Land Use / Planning
<input type="checkbox"/> Mineral Resources	<input type="checkbox"/> Noise	<input type="checkbox"/> Population / Housing
<input type="checkbox"/> Public Services	<input type="checkbox"/> Recreation	<input type="checkbox"/> Transportation / Traffic
<input type="checkbox"/> Utilities / Service Systems	<input type="checkbox"/> Mandatory Findings of Significance	

II. DETERMINATION

On the basis of this initial evaluation:

☒

I find that the proposed project COULD NOT have a significant effect on the environment.

☐

I find that the proposed project MAY have a significant effect on the environment. However, there are feasible alternatives and/or mitigation measures available that will substantially lessen any adverse impact. These alternatives are discussed in the attached written report.

☐

I find that the proposed project MAY have a significant effect on the environment. There are no feasible alternatives and/or feasible mitigation measures available that would substantially lessen any significant adverse impact. See the attached written report for a discussion of this determination.

Signature

Date

Printed Name

For

III. ENVIRONMENTAL IMPACTS

CEQA Checklist

Question	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
I. AESTHETICS - Would the project:				
a) Have a substantial adverse effect on a scenic vista?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d) Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
II. AGRICULTURE RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Involve other changes in the existing environment that, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
III. AIR QUALITY - Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

CEQA Checklist

Question	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?				
d) Expose sensitive receptors to substantial pollutant concentrations?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e) Create objectionable odors affecting a substantial number of people?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
IV. BIOLOGICAL RESOURCES - Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations, or by the California Department of Fish and Game or US Fish and Wildlife Service?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
V. CULTURAL RESOURCES - Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

CEQA Checklist

Question	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
d) Disturb any human remains, including those interred outside of formal cemeteries?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
VI. GEOLOGY AND SOILS - Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
ii) Strong seismic ground shaking?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
iii) Seismic-related ground failure, including liquefaction?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
iv) Landslides?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Result in substantial soil erosion or the loss of topsoil?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on-site or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
VII. HAZARDS AND HAZARDOUS MATERIALS - Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

CEQA Checklist

Question	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
VIII. HYDROLOGY AND WATER QUALITY - Would the project:				
a) Violate any water quality standards or waste discharge requirements?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on-site or off-site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on-site or off-site?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f) Otherwise substantially degrade water quality?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

CEQA Checklist

Question	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
h) Place within a 100-year flood hazard area structures that would impede or redirect flood flows?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
j) Inundation by seiche, tsunami, or mudflow?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
IX. LAND USE AND PLANNING - Would the project:				
a) Physically divide an established community?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
X. MINERAL RESOURCES - Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
XI. NOISE - Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

CEQA Checklist

Question	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
residing or working in the project area to excessive noise levels?				
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
XII. POPULATION AND HOUSING - Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
XIII. PUBLIC SERVICES				
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services: Fire protection? Police protection? Schools? Parks? Other public facilities?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
XIV. RECREATION - Would the project:				
a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
XV. TRANSPORTATION/TRAFFIC - Would the project:				
a) Cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

CEQA Checklist

Question	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e) Result in inadequate emergency access?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f) Result in inadequate parking capacity?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
XVI. UTILITIES AND SERVICE SYSTEMS - Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e) Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
g) Comply with federal, state, and local statutes and regulations related to solid waste?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
XVII. MANDATORY FINDINGS OF SIGNIFICANCE -				

CEQA Checklist

Question	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
b) Does the project have impacts that are individually limited, but cumulatively considerable? ('Cumulatively considerable' means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>